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TITLE:(U) SIGNAL PROCESSING DEMONSTRATOR SYSTEM FOR SPACE-BASED RADAR: SPD OPERATOR'S MANUAL
PERSONAL AUTHOR: Sawatsky, R.; Knight, T.; Collyer, R.
CORPORATE AUTHOR: MacDonald Dettwiler and Associates Ltd, Richmond BC (CAN);Defence Research Establishment Ottawa, Ottawa ONT (CAN)

ABSTRACT: (U) The SPD Operator's Manual contains instructions for the operation of the SBR Signal Processing Demonstrator (SPD). This document is prepared in the format of a 2167A Computer System Operator's Manual. The SPD is a laboratory-based computer system for the demonstration and validation of radar signal processing algorithms and real-time digital signal processing hardware for SBR. The SPD consists of a two subsystems: a Digital Signal Processor (DSP) and a Testbed. The DSP subsystem provides the demonstration of real-time signal processing for SBR signals. It consists of an ECCM Signal Processor (ESP) and a Radar Signal Processor (ESP) and a Radar Signal Processor (RSP).
DESCRIPTORS: (U) Spaceborne radar;Design;Signal processing;Algorithms;Spaceborne detectors;Radar detection;Digital systems

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SPACE-BASED RADAR PROJECT

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CONTRACTOR: MacDonald Dettwiler
Raytheon Canada

AUTHOR(S): R. Sawatsky, T. Knight
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RAYTHEON

SPD OPERATOR'S MANUAL

Approved by:

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SECTION ONE

SCOPE

1.1 IDENTIFICATION

This is the Operator's Manual for the Space-Based Radar (SBR) Signal Processing Demonstrator (SPD). This document describes the operation and maintenance of the SPD.

1.2 SYSTEM OVERVIEW

The SPD is a laboratory-based computer system for the demonstration and validation of radar signal processing algorithms and real-time digital signal processing hardware for SBR.

The SPD consists of two subsystems: a Digital Signal Processor (DSP) and a Testbed. The DSP subsystem provides the demonstration of real-time signal processing for SBR signals. It consists of an ECCM Signal Processor (ESP) and a Radar Signal Processor (RSP). The Testbed subsystem provides the environment required to operate, test and demonstrate the DSP. It consists of a Radar Signal Simulator (RSS) and a Testbed Controller. In principle, the Testbed is a complete test instrument capable of being used in conjunction with DSPs other than that developed under this contract.

1.3 DOCUMENT OVERVIEW

This operator's manual describes procedures for operating and maintaining the SPD. Physical assembly and installation of the SPD hardware is described in the Installation and Acceptance Test Procedures, document R-7.

This document includes the following as required by the SBR SPD Statement of Work (SOW) (Document A-2), for Contract Deliverable #22:

a) system preparation, power on and off, shutdown;

b) system initialization

c) operator controllable functions, modes and parameters

d) setup procedures for the operator to use in setting or programming desired functions, modes and parameters;

e) input and output procedures;

f) monitoring procedures;

g) recovery procedures;

h) off-line routine procedures

i) diagnostic features, procedures and tools;

j) error messages.

Document Format

This operator manual has been prepared in contractors format, which is adapted from DOD-STD-2167A for a Computer System Operator's Manual (DID-MCCR-80018A). Additional subsections have been added to describe interactive SPD features, and a section has been added covering computer system maintenance (Section 5).

Notational Conventions Used

italics	Used to denote commands, parameters, filenames or directories that are typed by the user into the system. Italics are also used to indicate remarks related to this version of the document, and the related version of the SPD software.
<text>	Indicates text inclusive with <...>, that are replaced with an alphanumeric string, e.g. run identifier, filename, etc.

"filename" Double quotes, when used in command text (in italics), generally should be retained in the command. I.e., the desired filename is placed between quotes. Examples include PVWave Command Language procedures and functions which require strings to be delineated by double quotes.

Audience

The reader should be familiar with general radar concepts, and an understanding of SBR concepts. In order to fully understand the HMI dialogues, the reader should also be familiar with the simulation concepts, models and algorithms used in the SPD. This Operator's Manual does not provide tutorial information on these topics. For a description of the DSP algorithms, the reader is referred to the DSP Detailed Design document (R-5), and for radar signal generation algorithms, see the Testbed Detailed Design (R-6). For more information on the SPD specifications, refer to documents R-2, R-3.

Organization of this Document

Sections of this document are organized as follows:

- Section 1 is an introduction to this document,
- Section 2 lists applicable and reference documents,
- Section 3 describes instructions for the operation of the SPD, including power on/off, initialization, shutdown, I/O, monitoring, recovery and off-line routine procedures,
- Section 4 describes diagnostic features of the system including diagnostic routines, fault isolation and interpretation of error messages,
- Section 5 describes maintenance procedures for the SPD,
- Section 6 contains notes including a complete list of all acronyms and abbreviations used in the system,
- Appendix A describes the conventions used in the Human-Machine Interface (HMI) dialogues, and the utility dialogues,
- Appendix B describes the Satellite/Radar Definition HMI, which is used to define the satellite and SBR sensor,
- Appendix C describes the Environment Definition HMI, which is used to define the radar environment including targets, clutter and jammers,
- Appendix D describes the Simulation Run HMI which is used to define SBR Signal processing parameters,

- Appendix E describes the Monitor/Control Simulation HMIs, which are used to control signal generation, and signal playback and processing,
- Appendix F lists all error messages produced by the SPD,
- Appendix G describes the HMI dialogues in the Range Ambiguity Resolution/Parameter Estimation (RAR/PE) HMI,
- Appendix H provides an alphabetical index to SPD HMI dialogues, and Simulation parameters in all the dialogues,
- Appendix I contains some notes related to the Software Development/Integration/Test Environment.

1.4 FUNCTIONS NOT IMPLEMENTED

The following SPD functions have not been implemented in the first release of the SPD software (SPD version 4.1, November 1994).

ESP:

Capture of the following intermediate results:

a) Nulling weight vectors;
b) Correlation matrices;
c) Cholesky factors;
d) Adaptive nulling snapshots;
e) Pulse Doppler window function.

RSP:

Capture of the following intermediate results:

a) DPCA weights;
b) DPCA target deweighting coefficients.

Testbed Controller:

a) Graphical field-of-view integrated with the Environment HMI (a separate graphical display routine is being developed by DREO);

b) Multi-group DPCA monopulse angle calculation;

c) Target latitude longitude in Parameter Estimation.

RSS:

The following models in radar signal generation:

a) Triangular array model (for CFA and auxiliary regular array);
b) Bolt Cassen/dipole/horn antenna element types;
c) Arbitrary auxiliary array antenna;
d) Externally-generated auxiliary element pattern;
e) Volumetric clutter (precipitation cells and chaff bundles;
f) Extended RRA models (aperture distribution error);
g) Jammer multipathing;
h) Ionospheric functions;
i) Correlated noise;
j) Build-up/build-down calculations.

Miscellaneous

Waveform duration is not computed by the RSS, therefore the Real-Time Rate Factor for playback and processing is not valid, and is not displayed.

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SECTION TWO

DOCUMENTS

2.1 APPLICABLE DOCUMENTS

There are no applicable documents to this Operator's Manual.

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SECTION THREE

COMPUTER SYSTEM OPERATION

3.1 COMPUTER SYSTEM PREPARATION AND SHUTDOWN

This section describes the procedures for computer system preparation and set-up prior to operation.

3.1.1 Power On and Off

The following explains the step-by-step procedures required to power-on and power-off the SPD.

3.1.1.1 System Power-up ("Cold Startup")

With all the equipment fully connected, and AC power available, power-on the SPD in the following order:

1. 5 GByte Exabyte tape drive and CD-ROM in either order. These terminating SCSI devices should be powered up first.

2. 1.3 GByte disk drive, 150 MByte tape, display monitors, printer. These peripherals may be powered-up in any order.

3. Controller and RSS workstations in either order. Each workstation auto-boots its own operating system. This process takes several minutes. Allow the workstations to complete boot-up before DSP/RTSG power-up. The workstation consoles should finish boot-up by displaying the login prompt. One should be able to log in via either console keyboards.

3.1.1.2 DSP/RTSG Power-up

If DSP operation is desired, then power-on the ESP, RSP and RTSG rack by operating the rack power switch to the "On" position to start sequenced application of AC power to these units in the equipment rack. The workstations should be allowed to complete autobooting before power is enabled to the equipment rack.

3.1.1.3 System Power-Off

To ensure system integrity, use the software shutdown procedure in subsection 3.1.3 before removing AC power from SPD subsystems. After the software shutdown has completed, power-off the system in the following order:

1. DSP/RTSG equipment rack off;
2. Workstations in either order;
3. Display monitors in either order;
4. All remaining peripherals, in any order.

3.1.1.4 DSP/RTSG Power-Off

To shut off power to the DSP/RTSG equipment rack while leaving the workstations running, use the "Shut-down Simulation Run" procedure in subsection 3.1.3 first. After the software shut-down has completed, remove power from the DSP/RTSG by operating the rack power switch to the "Off" position.

3.1.1.5 Typical Operating Conditions

Normally, the workstations are left running continuously day/nighttime, while the DSP/RTSG would be powered-up for simulation runs only.

3.1.1.6 Power Failure

In the event of AC power failure:

1. Set all equipment power switches to the "Off" position immediately after power fails.

2. Follow procedure for System Power-On (Cold Start) above after AC power has been restored.

The system can withstand unexpected loss of power, however, there is a possibility of data loss, or corruption of files that may have been in use at the time of power failure. Following workstation power-on, observe and check that rebooting occurs normally, and no hardware faults are detected. Attempt to restart the system with the software start-up procedures in the next subsection and note any anomalies. If unexpected system behaviour occurs, refer to the recovery procedures in subsection 3.2.3

3.1.2 Initiation

3.1.2.1 Operational Concept

The operational concept of the SPD is similar to other applications that run on a Sun workstation under Sun OS. It is run from a set of executable software images that are installed and resident on the file system. The chief difference is that the SPD includes software which runs on the DSP CPUs and VASP processing elements. The RSS and DSP are also single resources that can only service one user at a time.

To use the SPD, the user logs onto the system, either at one of the workstation consoles, or through a terminal connected to the SPD LAN. An Xterminal must be used to support the graphical input and output to the SPD. Once logged on, the user is free to create or alter their own simulation definition files, or to copy and reuse definitions previously saved in the filesystem. Subject to several restrictions, the definition files and simulation results are fully portable within the file system. The main restriction applies to the SRSD files which are not completely portable due to some path names embedded in their data structures.

3.1.2.2 After System Reboot

If the workstations have just rebooted, several processes must be initiated as follows:

1. PVWave license manager: Requires super-user privileges to restart. Execute these commands on both the "spdctlr" and "spdrss" workstations:

```
% cd /apps/vni/license/bin
% source start_pvwave
```

2. Simulation generation / simulation run servers: One server process is required for each of signal generation and simulation runs. To start up these servers, log in as spdmgr, and then use the commands *genstup* and *simstup* to start the servers. The DSP must be powered up and booting completed to do *simstup*.

3.1.2.3 SPD Applications

There are five main SPD applications which can be run:

1.	Satellite/Radar Definition:	Defines an SBR satellite and radar parameters
2.	Environment Definition:	Defines the radar environment parameters

3.	Signal Generation:	Compute the radar signal data for a given satellite/environment
4.	Simulation Run Definition:	Defines the run-time parameters for the DSP
5.	Simulation Run:	Playback and process previously-saved signals through DSP.

3.1.2.4 Application Start-up

An SPD application may be started by double-clicking on the corresponding icon, shown in Figure 3-1, or with a command line in a Unix shell. Since the application picks up the environment variables defined for that shell, it is often most convenient to start the HMI from the command line where the environment is known.

Pressing these icons will invoke the following start-up scripts stored in SPDMGRETC directory:

EnvDef.csh:	Environment Definition
RunDef.csh:	Simulation Run Definition
SatDef.csh:	Satellite/Radar Definition
SigGen:	Signal Generation
SimRun:	Simulation Run

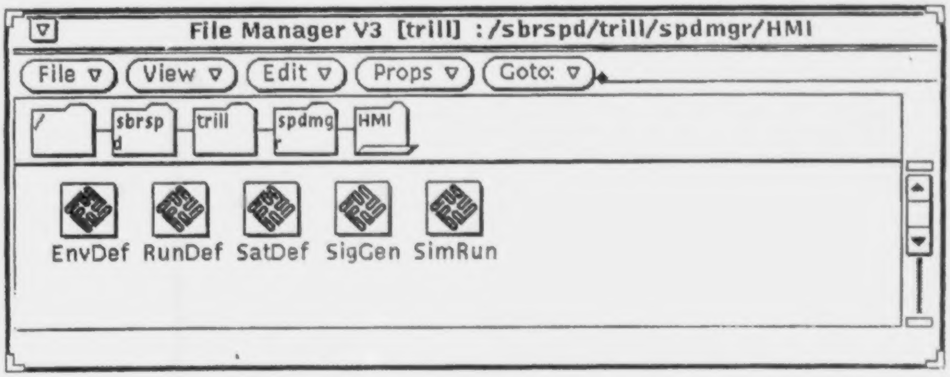

File Manager V3 [trill] :/sbrspd/trill/spdmgr/HMI
File ▽
View ▽
Edit ▽
Props ▽
Goto: ▽
/
sbrspd
trill
spdmgr
HMI
EnvDef
RunDef
SatDef
SigGen
SimRun

Figure 3-1 HMI Start-Up Icons

To start each of the above at the command line, use the following:

Satellite/Radar Definition:	*satdef*
Environment Definition:	*envdef*

Simulation Run Definition:	*simdef*
Signal Generation:	*siggen*
Simulation Run:	*simrun*

3.1.2.5 Preset Environment Variables

The SPD applications expect a number of Unix environment variables to exist. If these are not defined properly, unexpected behaviour may result. The following Unix environment variables are set in the default login file (normally in *~spdmgr/.spdrc)*, and should not be changed by the user. SPDMGRBIN and XPPLRESDIR should be altered only if customization of the executable binaries or X-windows resources is desired.

Variable	**Function**
CTLR_NODE	Specifies the Testbed Controller workstation node name
RSS_NODE	Specifies the RSS workstation node name
RTSG_NODE	Specifies the RTSG (CPU) node name
ESP_NODE	Specifies the ESP (CPU) node name
RSP_NODE	Specifies the RSP (CPU) node name
SPDMGR_HOME	Directory path to SPDMGR top-level directory
SPDLOG	Directory path to location for SPD message log files
SPDMGRBIN	Directory path to executable binary files for the SPD
SPDMGRETC	Directory path to SPD application scripts and utilities
SPDMMAP	Directory for database files generated by the RSS during Signal Generation, including: *antenna_dbase.vm* *cpa_dbase.vm* *cpa_index_dbase.vm* *cpc_dbase.vm* *ec_graz_dbase.vm* *ec_range_dbase.vm* *runconstants_dbase.vm* A subdirectory */data* under this directory contains the tropospheric refraction database file: *trop_ref.db*
SPDPVITOOLS	Top-level directory for all PVWave application procedures for SPD data ingest and display.

3.1.2.6 User-Alterable Environment

The SPD provides some flexibility in the destination directories for simulation definitions, results, intermediate data, and similar through several environment variables. The following are defined:

PARM_DIR	Directory for "parameters": definition files
SRSD_DIR	Directory for Simulated Radar Signal Data

PROD_DIR	Directory for simulation products (detection data, intermediate results, etc.)
ANAL_DIR	Directory for analysis data and results
LOGS_DIR	Directory for message log files generated from generations or "runs"
TARG_NORAND	This is used to disable random target fluctuation if set to "yes". Applicable to SPDMGR user only. See paragraph 3.1.2.7.
XAPPLRESDIR	Directory path to X11 application resources (see section 3.4 for details)

These may be set individually to organize input/output data into separate directories, or set to only one directory to keep all input data and results, log files, etc. together. Due to the large number of files that accumulate from a few simulations, it has been found most convenient to set these user directories to one directory related to a particular test case or SPD experiment, and change directories to conduct new experiments.

3.1.2.7 Non-Fluctuating Targets

The flag *TARG_NORAND* was added late during system testing to disable target random fluctuation which normally is modelled in the signal generation of individual target responses. Non-fluctuating targets are useful for certain tests where the randomness is not desired. In order to disable target randomness, the environment variable TARG_NORAND must be set to yes (*setenv TARG_NORAND yes) before* starting the Signal Generation server (*genstup).* The user must be logged in as SPDMGR to do this. This is necessary because the variable is read by the server processor only once when first started, and thereafter remains in effect until *genshdn* is done. If fluctuating targets is disabled, an info message will also be printed in the log file *rss_gen_status.log*.

3.1.2.8 SPDRC File

The SPD environment variables described above in sections 3.1.2.5 and 3.1.2.6, command aliases and path to SPD executables are defined in a hidden Unix file: *.spdrc*. This file is automatically "sourced" when the user's *.login* is executed. A default version of this file is found in: *~spdmgr/.spdrc*.

Figure 3-2 shows an example of the *.spdrc* file (actual version of *~spdmgr/.spdrc* as of October 18, 1994). This illustrates the definition of the node names, system directories and SPD default directories. The start-up alias commands for the SPD HMIs are also given. (The alias *siggen_host* and *siggen_cspi* were used to test versions of the RSS that ran entirely on the RSS host workstation.)

```
# Define whether to remove the randomness from target signals
setenv TARG_NORAND yes
#setenv TARG_NORAND no
#
# Define SPD Environment Variable Names
#
# Define Node Names
setenv CTLR_NODE trill-gw
setenv RSS_NODE  rss
setenv RTSG_NODE rtsg
setenv ESP_NODE  esp
setenv RSP_NODE  dax
#
# Define SPD System Directory Names
setenv SPDMGRHOME /home/trill/spdmgr
setenv SPDLOG     ${SPDMGRHOME}/log
setenv SPDMGRBIN ${SPDMGRHOME}/bin/spd-3.1
setenv SPDMGRETC ${SPDMGRHOME}/etc
setenv SPDMMAP    /sbrspd2/mmap_file
setenv SPDPVITOOLS /home/trill/spdcm/spd-3.0/src/ctlr/cdat
#
# Define X Resources file directory for the SPD HMI Applications
setenv XAPPLRESDIR ${SPDMGRHOME}/xres
#
# Define SPD Application Default Directories
setenv PARM_DIR  ${SPDMGRHOME}/parm
setenv SRSD_DIR  ${SPDMGRHOME}/SRSD
setenv PROD_DIR  ${SPDMGRHOME}/prod
setenv ANAL_DIR  ${SPDMGRHOME}/anal
setenv LOGS_DIR  ${SPDMGRHOME}/logs

#
# Define alias names for SPD HMI applications
#
alias satdef "crdh &"
alias envdef "cenh &"
alias rundef "csdh &"
alias siggen "cgeh &"
alias simrun "csih &"
alias siggen_host "source $SPDMGRHOME/.spdrc-rss-host;cgeh &"
alias siggen_cspi "source $SPDMGRHOME/.spdrc-rss-cspi;cgeh &"

# define PATH to include SPD's tools and executable directory

setenv PATH     .:${SPDMGRETC}:${SPDMGRBIN}:${PATH}
```

Figure 3-2 SPDMGR Version of .spdrc File

3.1.2.9 Customizing .spdrc

The SPD environment can be customized by the user by placing the following line in their *.login* file:

setenv MYSPDRC   invoke local version of .spdrc

This will cause the local user's version of *spdrc* to be sourced in addition to the default version in *~spdmgr/.spdrc*. This may be used to customize the SPD environment variables described in section 3.1.2.6.

3.1.3 Shutdown

The following SPD shut-down procedures are provided:

1. To turn off the DSP/RTSG
2. To shut down the Signal Generation server
3. To turn off all SPD equipment.

3.1.3.1 Shut-down DSP/RTSG

The DSP/RTSG is normally turned on only when simulation runs are being done, and otherwise may be left turned off without any impact to other SPD operations such as simulation definitions or signal generation. DSP/RTSG shut-down is also necessary to recover from fatal DSP or RTSG errors. To shut down the DSP/RTSG equipment rack:

1. Shut down the simulation run server with the Unix command: *simshdn*

2. Wait a few moments, then operate the power-off button on the RTSG/DSP equipment rack.

3.1.3.2 Shut-down Signal Generation

The Signal Generation server is normally left running as long as the workstations are powered-up. If the workstations are to be powered down, the signal generation server should be shut-down first. Server shut-down may be also necessary to recover from fatal RSS errors. To shut down the signal generation server, type the command: *genshdn*

3.1.3.3 System Shut-down

Before power is removed from the SPD system, the SPD software and operating system should be shut-down gracefully with the following procedure:

1. Shut-down the signal generation and simulation run servers as above,

2. Perform a shut-down of the operating system on both workstations (see Sun OS references)

3.2 Operating Procedures

This section describes the following operating procedures for the SPD:

- Defining simulation scenarios
- Generating signal data ("Signal Generation")
- Processing signal data ("Simulation Run")

- Analysis of results using PVWave visual data analysis software

For operation of non-developmental software, also refer to vendor documentation. For details on SPD diagnostic procedures, see Section 4.

3.2.1 Simulation Definition

SPD simulation definition is organized into three parts:

1. Satellite/Radar definition:	Define satellite orbit, radar sensor, location of beam each dwell.
2. Environment Definition:	Define radar environment consisting of moving targets, jammers, clutter, noise, and propagation effects.
3. Simulation Run Definition:	Define digital signal processing parameters for the playback and processing of simulated radar signals.

3.2.1.1 Simulation Definition Activity

Each of the definition activities above are started and run as separate Unix processes. Once started, the user is provided with a graphical interface with which to enter parameters, or change previously saved definitions. Multiple copies of the definition program may be run by one user on a workstation, or multiple users on different workstations.

3.2.1.2 Invoking a Definition HMI

A simulation definition HMI may be started by directly invoking the associated binary program and running in the background of a Unix shell (indicated by the "&" character following the program name). The program name is actually the name of the corresponding CSU which contains the "main" C program. A single word alias is also provided, and is more typically used to start the HMI. The following lists two ways to start the simulation definitions:

Activity	Unix Command	Alias Command
Satellite/Radar Definition	*crdh &*	*satdef*
Environment Definition	*cenh &*	*envdef*
Simulation Run Definition	*csdh &*	*rundef*

3.2.1.3 Problems

If the alias commands do not work, it is likely they were not included in the user's *.login* at start-up. If necessary, execute the login script in the SPDMGR account with the command: *source ~spdmgr/.login*

3.2.1.4 Default Directory

The default directory for the definition files, which is first used, if an "Open" command is used, is defined by the environment variable *PARM_DIR*. This name will be picked up and used for the initial directory path appearing in the *"File Name"* field in the top-level dialogue.

3.2.1.5 Concept of Definition Files

The SPD simulation definitions are basically data structures which are created in program memory, or loaded from previously saved files, then edited and saved to an existing or new file. The data structures are defined in the SPD interface definition files (**.h*) files, and are saved in eXternal Data Representation (XDR) format. The files are not directly readable, except using the HMI or the on-line C debugger.

Each definition HMI provides a common set of file related functions to create a new definition, open an existing file, save to an existing or new file, and to quit the HMI. These functions are accessed from the "File" menu bar item.

Naming convention:	*<id>.pa.sar_def*	Satellite/Radar Definition file
	<id>.pa.env_def	Environment Definition file
	<id>.pa.sim_def	Simulation Run Definition file

Where *<id>* is a user-entered identifier for that definition.

3.2.1.6 Satellite Radar Definition

Concept

The Satellite/Radar definition HMI is used to define satellite orbit, radar sensor, location of beam each dwell, and radar waveform. The definition of the radar waveform in dwells, NCIs, and CPIs forms the time-base over which radar signals are generated. Together with the Environment HMI, these definition files form the input to the radar signal generation process.

Description of Satellite/Radar HMI

Refer to Appendix B.

3.2.1.7 Environment Definition

Concept

The Environment Definition HMI is used to define the radar environment including moving and fixed targets, terrain clutter, artificial clutter (e.g. fixed discretes, chaff clouds), jammers (either fixed or moving), noise, and propagation effects. The environment definition is used together with a specified Satellite/Radar definition to define a unique simulated radar signal. One environment definition can be used with many satellite/radar definitions to experiment with performance as a function of the satellite and radar sensor.

Description of Environment Definition

Refer to Appendix C.

3.2.1.8 Simulation Run Definition

Concept

The Simulation Run HMI is used to define the signal processing parameters used for playback and processing. Since many signal processing parameters are constrained by the signal being processed, a new Simulation Run Definition HMI will first prompt the user to select a radar Signal Data file, specified by the "RSS Parameter" file (*.pa.rss_prm). The HMI will use the RSS parameter file to access the Satellite/Radar definition, and derived RSS parameters, to initialize the Simulation Run parameters. This initializes a number of display-only values in the Simulation Run HMI (that can only be altered by regenerating the signal), and a number of dependent constraints, range of values (e.g. number of auxiliaries), etc.

Description of Simulation Run Definition

See Appendix D.

3.2.2 Signal Generation

3.2.2.1 Concept of Operation

Signal Generation is the process of computing a Simulated Radar Signal Data (SRSD) file for a specified pair of Satellite/Radar Definition and Environment Definition files. Setup, control and monitoring of Signal Generation activity is provided by the Signal Generation Monitor/Control HMI.

3.2.2.2 Invoking Monitor/Control HMIs

A Signal Generation HMI is started by running the program in the background of a Unix shell with the command:

```
cgeh &
```

or by the single word alias:

```
siggen
```

More than one Signal Generation Monitor/Control HMI can be started by the user on either workstation, or by different users on different workstations, however, only one signal generation activity is permitted to run at a time. The Signal Generation server process ensures this exclusion.

3.2.2.3 Files Created

Signal generation produces the following files:

<genid>.ir.<rss_ir>	RSS intermediate results file (if enabled)
<genid>.lg.gen_err	Log file of ASCII messages (info, warnings, errors)
<genid>.pa.rss_prm	RSS derived parameters
<genid>.pa.rss_prm.pa.sar_def	Associated satellite/radar definition
<genid>.pa.rss_prm.pa.env_def	Associated environment definition
<genid>.sg.srsd	Simulated radar signal data file

Since subsequent processes including simulation run and parameter estimation require information on the satellite/radar and environment, the signal generation processes creates two "associated" files for their use: 1) an associated satellite/radar definition, and 2) associated environment definition. These two files are in the same format as the "unassociated" definition files, however, should not be altered as they must be consistent with the signal data generated to ensure proper subsequent processing.

Table 3-1 lists the RSS intermediate results that can be generated during signal generation and the default filenames used. The filenames begin with the signal generation "run identifier" specified in Signal Generation Monitor/Control HMI. RSS intermediate result files are only created for those results enabled in the Satellite/Radar definition. Section 3.2.5.1 describes PVWave routines for plotting RSS intermediate results.

Table 3-1 RSS Intermediate Results and Filenames

Intermediate Result Type	File Name (Note 1)
Clutter	*<genid>.ir.rss_clut*
External Noise	*<genid>.ir.rss_exn*
Jammers (Note 2)	*<genid>.ir.rss_jam.<n>*
Targets (Note 2)	*<genid>.ir.rss_tar.<n>*
Composite	*<genid>.ir.rss_comp*
Post Non-Linearity	*<genid>.ir.rss_post_nl*
Post IF Filter	*<genid>.ir.rss_if_filt*
Post Sync Detector	*<genid>.ir.rss_post_sd*
A/D Output (Note 3)	*<genid>.ir.rss_post_ad*
Rx Antenna Pattern (Note 4)	*<genid>.ir.rss_ant_patrn*
IF Filter Response	*<genid>.ir.rss_filt_rsp*
Tx Antenna Pattern (Note 5)	*<genid>.ir.rss_ant_patrn*

Notes:

1. *<genid>* = Generation Identifier
2. One file created for each target or jammer, counting from zero <n> = 0,1,2... N-1, where N = number of targets or jammers.
3. Equivalent to Simulated Radar Signal Data stored for playback.
4. Appended after tx ant pattern(if enabled)
5. Same filename as rx ant pattern.

3.2.2.4 Description of Signal Generation Monitor/Control HMI

See Appendix E.

3.2.3 Simulation Run

3.2.3.1 Concept of Operation

Simulation Run is the activity of playing back and processing a radar signal data file through the DSP, and capturing detection data and intermediate DSP results. Setup, control and monitoring of a Simulation Run is provided by the Simulation Run Monitor/Control HMI.

3.2.3.2 Invoking Simulation Run Monitor/Control HMI

The Simulation Run Monitor/Control HMI is started in a Unix shell by typing the program name to run it in the background: *csih &*, or typing the alias command: *simrun*. Similar to signal generation, more than one Simulation Run Monitor/Control HMI may be opened, however, only one is allowed access to the DSP at a time. The Simulation Run server process ensures this exclusion of use.

Once started, the user specifies the radar signal data filename, and a related Simulation Run definition.

3.2.3.3 Files Created

Simulation run activity produces the following files:

<runid>.pa.dsp_prm	Binary file containing DSP processing parameter structure created by the Testbed Controller and passed to the DSP for the run.
<runid>.dt.detection	Binary file of detection data. A list of detections is generated for each NCI. Refer to section 3.2.1.5 of the DSP/Testbed Detailed Design (Document R-9) for details on the data elements and organization of detections.
<runid>.ir.<DSP_IR>	DSP intermediate results files: there is one file created for each type of intermediate result enabled in the Simulation Run definition.
<runid>.lg.sim_err	Log file (ASCII) of messages generated by the RTSG, ESP and RSP during processing. Log files generated separately by each unit are appended together into this file.

Table 3-2 lists the DSP intermediate results that can be generated during a Simulation Run and the default filenames used. The filenames begin with the simulation run "run identifier" specified in the Simulation run Monitor/Control HMI. DSP intermediate result files are only created for those products enabled in the Simulation Run definition (in the ESP Intermediate Results and RSP Intermediate Results dialogues). Section 3.2.5.2 describes PVWave routines for plotting DSP intermediate results.

Table 3-2 DSP Intermediate Results Filenames

Intermediate Result Type	File Name (Note 1)
ESP Input Signals	*<runid>.ir.esp_inp*
Post Sampling Correction (SC)	*<runid>.ir.esp_post_sc*
Post Adaptive Nulling (AN)	*<runid>.ir.esp_post_an*
Post Pre-Doppler Blanker	*<runid>.ir.esp_post_pdb*
Post MASR DPCA	*<runid>.ir.esp_post_masr*
Post Frequency Alignment (FA)	*<runid>.ir.esp_post_fa*
Post Pulse Doppler (PD)	*<runid>.ir.esp_post_pd*
RSP Input Signals	*<runid>.ir.rsp_inp*
Post Pulse Compression (PC)	*<runid>.ir.rsp_post_pc*
Post ASAR DPCA	*<runid>.ir.rsp_post_cc*
Post RCS	*<runid>ir.rsp_post_rcs*
Post Range-Doppler Blanker	*<runid>.ir.rsp_post_rdb*
Post NCI	*<runid>.ir.rsp_post_nci*
Monopulse Angle Matrix	*<runid>.ir.rsp_mono_mx*
Notes: *<runid>* is the Simulation Run identifer.	

3.2.3.4 Description of Simulation Run Monitor/Control HMI

See Appendix E.

3.2.4 Parameter Estimation

Parameter Estimation performs the "Parameter Estimation" algorithm functions consisting of range ambiguity resolution, target angle, target RCS and velocity. The algorithms are described in the DSP Detailed Design, Appendix A, section A17. The Parameter Estimation function is implemented in PVWave command language and runs "stand-alone" on the workstation host. It accepts ambiguous-range detection data generated by the RSP (from a saved file), and computes unambiguous target range, target angle, RCS and velocity. The generalized range ambiguity resolution algorithm solves *M of N* detection for up to 12 NCIs. The results are saved to a file and a graph of the unambiguous range/resolved velocity of target detections is produced.

The default directory for detection data and DSP processing parameters used by Parameter Estimation is the environment variable PROD_DIR. This directory should contain both the detection file (**.dt.detection*) and the DSP processing parameters file (**.pa.dsp_prm*).

Running Parameter Estimation with Interactive HMI:

1. Start PVWave Command Language at the Unix prompt with the command: *init_wave*

2. At the Wave prompt, load and compile the procedure with the command:

```
WAVE> @init_rar
```

3. Start the Parameter Estimation (HMI version) function with the command:

```
WAVE> x = compute( )
```

   This invokes the HMI pop-up dialogue titled "Data Selection". Note that this Wave procedure will not work from the Command Language window inside Wave Point & Click.

4. In the Data Selection HMI, define the following:

   Input File Select: Move to the desired directory and select the detection data file

   Output Root File Select: Enter a character string to identify this RAR run

   Dwell Select: Click on "Accept Slider", choose a DI number, and then "OK"

   M Selection: Select value of M for M of N range ambiguity resolution. (This selection replaces the value set by "Number of PRFs Used" in the Simulation Run definition under DI Level: RAR.)

   See Appendix G for illustration of the RAR/PE dialogues.

   Parameter Estimation will then read the detection data file and compute unambiguous ranges. It will then print the numerical results in the shell tool, and plot velocity (y) vs range (x).

5. RAR debug output is produced with the filename: *<rootname>_<dwellnum>* where *rootname* is the root file name, and *dwellnum* is the dwell number, entered above.

6. A 2-D velocity (in m/s) vs range (in km) is plotted in an X-Window. The foreground colour (*FG_COLOR*) and background colour (*BG_COLOR*) are defined in *cdat_rar_compute_intf.pro*

7. Use the OpenWindows Snapshot utility to capture and print a hardcopy of the plot, if desired.

8. Repeat from step 3 for different files, dwells, or choices of M. Type *quit* at the Wave> prompt to exit.

Running Parameter Estimation with Command Language Function

The RAR/PE function can also be run as a command language function which accepts parameters instead of through the HMI.

1. Start PVWave Command Language as above.
2. Initialize RAR/PE with *init_rar* as above.
3. Start RAR/PE with the command:

   wave > *x = compute_rar ("<runid>", d, m)*

   where

   <"runid"> is simulation run identifier.

   d = Dwell to process (1,2,...). If d = 0, then all dwells will be processed.

   m = Number of NCIs, or M value, for M of N RAR.

   N is the number of NCIs in the dwell. Note that this overrides any value selected in the Simulation Run DI Level: RAR dialogue.

4. RAR/PE uses *<runid>* to form the following filenames.

Detection data:	*<runid>.dt.detection*
DSP Parameters:	*<runid>.pa.dsp_prm*
Output File:	*<runid>_<d>* where *<d>* = dwell number

The detection data and DSP parameters must be in the current simulation products directory defined by the environment variable *PROD_DIR*.

3.2.5 Visual Data Analysis and Display using PVWave

Functions to plot SPD intermediate results have been implemented in PVWave Command Language (WaveCL), and PVWave "Point & Click" (WavePC). WaveCL provides a command-line style of interactive data analysis. Customized functions and procedures are built on top of the intrinsic functions provided by Visual Numerics. WavePC provides an interactive graphical HMI layer on top of WaveCL. WavePC version 2.2 includes a feature to execute WaveCL commands and functions, provided they are non-graphical. These provide a powerful tool for analyzing the signal data, from stages within generation, through processing and detection (ambiguous) output. PVWave is also used in the Parameter Estimation function.

3.2.5.1 Displaying RSS Intermediate Results

Two methods are provided for the ingest and 3D plotting of Radar Signal Simulator intermediate results. These are:

- WaveCL procedure with graphical user interface;
- "In-line" WaveCL procedure.

3.2.5.1.1 Plotting 3D Graph Controlled from Graphical User Interface

A self-contained PVWave program is provided to ingest and display Radar Signal Simulator intermediate results. The program runs stand-alone and interactively with the user to display any of the RSS intermediate results enabled during generation. Note that the file names begin with the signal generation run identifier that is specified when signal generation is started. (see section 3.2.2 above)

The following procedure is used to start up and display RSS intermediate results:

1. Start PVWave Command Language at the Unix prompt with the command: *init_wave*

2. At the Wave prompt, load and compile the plotting routines with the command:

   ```
   WAVE> @init_rssir
   ```

3. Start the function with the command:

   ```
   WAVE> process_ir
   ```

4. In the HMI pop-up, define the following in the order (a), (b), (c):

   a) **Input File Select**: Select desired directory and data file. (<*IRfilename*>)

   b) **CPI Selection**: Specify the CPI number; this is the number of the CPI from the first one (DI 1, NCI 1) generated, counting up from "1", and assumes all CPIs are captured.

c) **Postscript**: Choose Yes to generate a Postscript file of the graph; otherwise No. If "Yes" is selected, the graph will be saved in a postscript file named as *<IRfilename>.ps* where *<IRfilename>* is the input file selected above. For example, a plot of the first jammer from *"gen2"* would be saved to *gen2.ir.rss_jam.0.ps.*

Plot is automatically produced in an Xwindow after (c) is selected.

5. To plot a transmit or receive antenna pattern, do:

```
WAVE> @init_rssant
WAVE> process_ant
```

then select the filename of the desired antenna pattern file. The program will then plot the pattern. Postscript file output is not supported, however, the graph can be captured and printed using the OpenWindows snapshot utility.

6. To plot an RSS IF filter response, do:

```
WAVE> @init_rssif
WAVE> process_if
```

then select the filename (*<genid>.ir.rss_filt_rsp*) and Postscript file enable flag. A 2D plot of the filter response is plotted in an X-window. The output Postscript file (if enabled) is named *<genid>.ir.rss_filt_rsp.<chanid>.ps.*

The PVWave procedure files for the above are stored in *${SPDPVITOOLS}ingestrss* under the filenames: *init_rar.pro*, *init_rssant.pro*, and *init_rssir.pro.*

3.2.5.1.2 Plotting 3D Graph of RSS Data from In-Line WaveCL Procedure

A second method of plotting a 3D graph of RSS intermediate results is provided in the form of an "in-line" WaveCL procedure which avoids the use of the graphical HMI. A function *surf_rssir* has been implemented to accept parameters directly. This allows the procedure to be called from within another WaveCL procedure.

To plot a 3D graph of an RSS intermediate result using *surf_rssir*, do the following:

1. Start WaveCL as above with the command *init_wave.*
2. Initialize the plot routines in WaveCL with: *@init_rssir*. If this was previously done in a WaveCL session, it does not have to be repeated.

3. Invoke the 3D plot on an RSS intermediate result file with the following command:

```
WAVE> surf_rssir, "filename", d, n. cp, ch, ps
```

where

"filename" is the name of the RSS intermediate result file; see Table 3-1 for filename convention used.
d = 1, 2, 3... is the dwell number;
n = 1, 2, 3... is the NCI number in dwell "d";
cp = 1, 2, 3... is the CPI number in NCI "n";
ch = 1, 2, 3... is the channel number; and
ps = "PS" or "N" ("PS" generates a Postscript file).

The dwell, NCI and CPI numbers correspond to the DI/NCI/CPI identifier specified in the Satellite/Radar definition. For example, if the first and third CPI were enabled for capture, then valid values of *cp* would be 1 and 3.

However, "chan" does not correspond to the channel identifier, but is the sequential number in which the channel is captured. For example, if a signal were generated with 3 main phase centres and 2 auxiliaries, but only the centre main phase and first auxiliary were enabled for capture, then *ch* = 1 would correspond to the centre main phase centre, and *ch* = 2 would correspond to the first auxiliary.

3.2.5.2 Displaying DSP Intermediate Results

PVWave functions are provided for the ingest and display of the DSP intermediate results. Unlike the RSS intermediate results, the DSP ingest and plotting capability is packaged as a set of functions, callable from within Wave. To use these functions, the WaveCL or P&C application is first invoked, and these functions are then compiled and used. Two sets of PVWave command language procedures are provided for the DSP products: 1) 3D surface plots, and 2) data ingest routines.

3.2.5.2.1 Generating a 3D Plot of an Intermediate Result in Wave Command Language

The set of functions for 3D surface plot procedures are packaged into a single WaveCL procedure: *surf*. This uses the WaveCL function *shade_surf* to render the selected data as a 3D shaded surface plot. The 3D surface plot procedure files are located in the directory: *${SPDPVITOOLS}/3dplots*.

To plot a 3D surface of a DSP intermediate result:

1. Start PVWaveCL with the command: *init_wave*

2. Initialize the surface display routines with the command:

```
WAVE> @init_display
```

3. Invoke the surface procedure on an intermediate file with the following command:

```
WAVE> surf, "filename", d, n, cp, ch, ps, nr, nv
```

where:

"filename" is the name of the intermediate result file - see list for the naming convention used for ESP and RSP intermediate results,

d = 1, 2, 3, ... is the dwell number,

n = 1, 2, 3, ... is the NCI number in dwell "d"

cp = 1, 2, 3, ... is the CPI number in NCI "n",

ch = 1, 2, 3, ... is a channel number, see Table 3-3 for specific interpretations,

ps = "PS" or "N" ("PS" generates a Postscript file of the surface plot)

nr = number of range gates (detection data files only)

nv = number of velocity bins (detection data files only)

If the Postscript file is enabled, *surf* generates a file with the default name *<filename>.ps*, for example, ESP input for "run1" would be written to *run1.ir.esp_inp.ps*

4. If the specified data interval and channel exists in the intermediate result file, it will be read in (the dimensions are echoed in the command tool) and a surface plot generated. If the data interval does not exist, an error message is generated.

The format of the dimensions message is:

```
dimX: nn      dimY: nn      dimZ: nn
```

5. Step 3 may be repeated as desired, however, the data is not saved in the WaveCL workspace.

Table 3-3 lists the ESP and RSP intermediate results, the syntax for the 3D surface routine, and the internal Wave procedure that plots the data. The dwell, NCI, CPI and channel parameters are consistent with those described in Sections 3.2.1.7.1 to 3.2.1.7.2.3 of the DSP/Testbed Interface Detailed Design (Document R-9). Refer to this document for further details on the data format, organization and dimensions of the DSP intermediate results.

Table 3-3 DSP Intermediate Results, 3D Surface Routines

Intermediate Result	**Syntax (Note 1)**
ESP Input	surf, "runid.ir.esp_inp", d, n, cp, ch, ps
Post SC	surf, "runid.ir.esp_post_sc", d, n, cp, ch, ps
Post FA	surf, "runid.ir.esp_post_fa", d, n, cp, ch, ps
Post AN	surf, "runid.ir.esp_post_an", d, n, cp, ch, ps
Post MASR	surf, "runid.ir.esp_post_masr", d, n, cp, ch, ps
Post Pre-Doppler Blanker	surf, "runid.ir.esp_post_pdb", d, n, cp, ch, ps
Post Pulse Doppler	surf, "runid.ir.esp_post_pd", d, n, cp, ch, ps
RSP Input	surf, "runid.ir.rsp_inp", d, n, cp, ch, ps
Post PC	surf, "runid.ir.rsp_post_pc", d, n, cp, ch, ps
Post ASAR	surf, "runid.ir.rsp_post_cc", d, n, cp, ch, ps
Post RCS	surf, "runid.ir.rsp_post_rcs", d, n, cp, ch, ps
Post range-Doppler Blanker	surf, "runid.ir.rsp_post_rdb", d, n, cp, ch, ps
Post NCI (Note 2)	surf, "runid.ir.rsp_post_nci", d, n, cp, ch, ps
Monopulse Angle Matrix (Note 3)	surf, "runid.ir.rsp_mono_mx", d, n, cp, ch, ps
Post Detection (Note 4)	surf, "runid.ir.detection", d, n, cp, ch, ps, nr, nv

Notes:

1. Uses PVWave procedure syntax. Parenthesis do not enclose parameters. Replace "runid" with run identifier. See text for other parameters.
2. For post NCI data: 'cp' value is ignored; ch = 1 for signal power, ch = 2 for monopulse angle (if monopulse enabled).
3. For monopulse angle matrix, 'ch' is ignored.
4. For detection data, the total number of range gates (nr), and total number of Doppler velocity bins (nv) must be specified. Detections are plotted in 2D graph.

3.2.5.2.2 Ingesting a DSP Intermediate Result into Command Language

A second set of functions provide data ingest capability to PVWave. These functions are defined individually for each intermediate result type, and may be used to ingest a specified data interval into WaveCL for subsequent analysis, or can be called from within Wave P&C 2.2.

To read in a DSP intermediate result:

1. Start WaveCL at the Unix prompt with the command:

```
% init_wave
```

2. Initialize the read routines:

```
WAVE> @init_read
```

3. Refer to Table 3-4 and invoke the desired intermediate result ingest function. The general syntax is:

```
WAVE> x = read_..._... ("filename", d, n, cp, ch)
```

   This will assign a two-dimensional array containing the captured data to the variable "x" in the PVWave workspace, where it can be manipulated and displayed. The size of "x" depends on the burst size, and whether any data reduction was enabled. The type of data (real or complex) will depend on the product type and whether magnitude-squared was enabled.

The dwell, NCI, CPI and channel parameters for the read functions are the same as those for the 3D surface plotting procedures. Refer to Section 3.2.1.7 of the DSP/Testbed Interface Detailed Design (Document R-9) for further details on the data format, dimensions and organization of the DSP intermediate results.

Table 3-4 DSP Intermediate Result Read Functions

Intermediate Result Type	Syntax (Note 1)
ESP Input Signals	read_esp_input ("runid.ir.esp_inp", d, n, cp, ch)
Post Sampling Correction Signals	read_post_nulling ("runid.ir.esp_post_sc", d, n, cp, ch)
Post Adaptive Nulling Signals	read_post_sc ("runid.ir.esp_post_an", d, n, cp, ch)
Post Pre-Doppler Blanker Signals	read_post_pdb ("runid.ir.esp_post_pdb", d, n, cp, ch)
Post MASR Signals	read_post_masr ("runid.ir.esp_post_masr", d, n, cp, ch)
Post Frequency Alignment Signals	read_post_fa ("runid.ir.esp_post_fa", d, n, cp, ch)
Post Pulse Doppler Signals	read_post_pd ("runid.ir.esp_post_pd", d, n, cp, ch)
RSP Input Signals	read_rsp_input ("runid.ir.rsp_inp", d, n, cp, ch)
Post Pulse Compression Signals	read_post_pc ("runid.ir.rsp_post_pc", d, n, cp, ch)
Post Clutter Cancellation (ASAR) Signals	read_post_cc ("runid.ir.rsp_post_cc", d, n, cp, ch)
Post RCS Signals	read_rcs ("runid.ir.rsp_post_rcs", d, n, cp, ch)
Range Doppler Blanked Signals	read_rd_blanked ("runid.ir.rsp_post_rdb", d, n, cp, ch)
Post NCI Signal (Note 2)	read_post_nci ("runid.ir.rsp_post_nci", d, n, cp, ch)
Monopulse Angle Matrix (Note 3)	read_monopulse ("runid.ir.rsp_mono_mx", d, n, cp, ch)
Nulling Weight Vectors	*("runid.ir.esp_nwt_vec", d, n, cp, ch)
Correlation Matrices	*("runid.ir.esp_corr_mx", d, n, cp, ch)
Cholesky Factor Matrices	*("runid.ir.esp_csky_fact", d, n, cp, ch)
Adaptive Nulling Snapshots	*("runid.ir.esp_an_snap", d, n, cp, ch)
Pulse Doppler Window Function	*("runid.ir.esp_pd_win", d, n, cp, ch)
ASAR DPCA Weights	*("runid.ir.rsp_dpca_wg", d, n, cp, ch)
Target Deweighting Function	*("runid.ir.rsp_tar_dw", d, n, cp, ch)
Pulse Compression Replicas	read_pc_replicas ("runid.ir.rsp_repli", d, n, cp, ch)

Notes:

1. Uses PVWave function syntax. Parenthesis required around parameter list. Replace "runid" with run identifier. See text for other parameters.
2. For post NCI data: 'cp' value is ignored; ch = 1 for signal power, ch = 2 for monopulse angle (if monopulse enabled).
3. For monopulse angle matrix, 'ch' is ignored.

* Read routine not implemented in SPD Version 4.1 (November 1994).

3.2.5.2.3 Ingesting a DSP Intermediate Result into Point&Click

The data ingest routines above can also be run from within PVWave P&C 2.2 from a Wave command window, with the following:

1. Start P&C2.2 from a Command Tool or Xterm window with the command *init_wavepc*

2. In the PVWave P&C Home window, select the menu item *Wave -> PV-Wave Commands* and a command window will be opened.

3. Follow the procedures above to initialize the ingest routines, and read data in. When P&C ingests the data, it will appear in the *Home* window with a matrix icon under *Original Variables*. If data ingest is not successful a 1x1 matrix (scalar value) will be produced.

4. Wave P&C may then be used to analyze and display the ingested data. The following are some common ways of viewing the data:

   Statistics: To get immediate statistics on a matrix, double-click on its variable icon and an information box of maxima, minima, etc. is displayed.

   Table: To display the numerical values directly in tabular form, select the matrix and then choose *View -> Tabular.*

   3D Surface: To plot a 3D surface of the data, similar to *surf*, use the menu item *View -> Surface.* If complex data is read in, it must be first converted to magnitude (use *Process -> Math -> abs( )* function to create a derived magnitude matrix).

   2D Image: To render a matrix of real valued data as image intensity, use the menu item *View -> Image*. PVWave follows the convention of placing the (0,0) matrix value in the lower left corner.

Notes about Data: The orientation of range and pulses/Doppler depends on the product captured: ESP products have range samples in rows, and pulses in columns, so plotted 2D images have range in the vertical axis, and pulses running across. In the RSP, the data is corner-turned with range samples running across, and Doppler is vertical.

Notes about Point&Click: A conflict in colourtable use may arise when running the SPD HMIs and Wave Point&Click on the workstation. This is evidenced by Wave P&C crashing with an "Xlib Integer out of range" error. To avoid this, select the following from the P&C Option>Setup "Home" menu bar:

Options>Setup
"Number of Display Colours" set to 128, not "Optimal"

This setting may be saved by doing "Save" under "Option Defaults" in the Options>Setup dialogue.

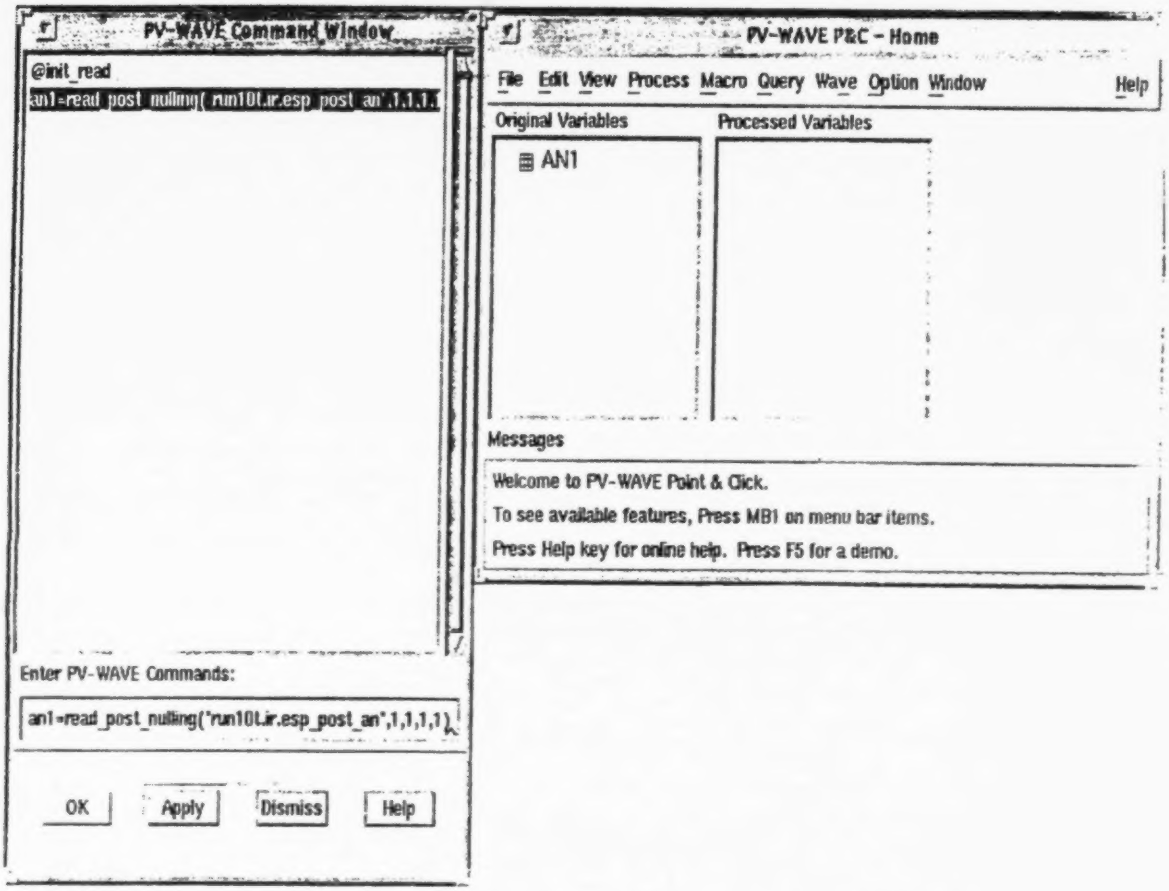
Example

Figure 3-3 illustrates an example of Wave P&C after ingesting ESP post adaptive nulling signal data to a variable called "an1".

The following WaveCL commands were executed inside the PVWave Command Window:

@init_read
an1 = read_post_nulling("run01t.ir.esp_post_an", 1, 1, 1, 1)

Carriage return or "Apply" may be used to execute each command and keep the Command Window open. "OK" will execute the command and close the PVWave Command Window.


PV-WAVE Command Window
Enter PV-WAVE Commands:
OK
Apply
Dismiss
Help
PV-WAVE P&C - Home
File
Edit
View
Process
Macro
Query
Wave
Option
Window
Help
Original Variables
Processed Variables
AN1
Messages

```
@init_read
an1=read_post_nulling('run10t.ir.esp_post_an',1,1,1,1
```

```
an1=read_post_nulling("run10t.ir.esp_post_an",1,1,1,1)
```

Welcome to PV-WAVE Point & Click.
To see available features, Press MB1 on menu bar items.
Press Help key for online help. Press F5 for a demo.

Figure 3-3 Example of Ingesting DSP Intermediate Data into Wave P&C

3.2.6 Input and Output Procedures

Simulation definitions and data are saved and retrieved to off-line devices (Exabyte tape and QIC-150) using regular Unix commands such as *tar* (tape archive). In most cases the Exabyte (8 mm) tape is preferable with its large (approximately 5 GByte compressed format) capacity. The two CD-ROM drives in the SPD, one connected to each workstation, are mainly used for loading third party software onto the system.

3.2.6.1 Archiving/Restoring Files

All SPD files (definitions, intermediate data, programs, etc.) are managed as ordinary Unix files within directories.

To archive a directory of files to the Controller Workstations, do the following:

1. Switch on tape drive (if not on).

2. Put in a tape and close door.

3. Mount it from Unix with the command:

```
mt -f /dev/rst5 status
```

   This will mount the tape and return its status. If the tape is not rewound, use *mt* to rewind it. (See *man mt* under Unix "man" pages for details.)

4. If not in desired directory to save, change to the desired directory.

5. Save the directory with Unix tape archive with the command:

```
tar  -cvf  /dev/rst5  <directory>|<filenames>
```

   where:

   <directory> is the directory of files to be saved and *<filenames>* are (optionally) the files to be saved.

   To restore a file, follow the procedure above, substituting the following command of step 5:

```
tar  -xfv  /dev/rst5
```

   which will restore the archived files to the current directory.

3.2.6.2 Device Names

The following table lists the physical device names (under /dev/) for SPD digital storage devices on the Controller and RSS workstations.

	Controller	RSS
150 MByte QIC tape	rst4	none
5 GByte 8 mm tape	rst5	rst0
665 MByte CD-ROM	rsr0	rsr0

3.2.7 Monitoring Procedures

This section describes SPD features used to monitor signal generation and simulation run activity. Remarks are included on trouble and malfunction indications, however, this is not an exhaustive treatment of fault indication.

3.2.7.1 Signal Generation Monitoring

Signal generation activity can be monitored in the following ways: 1) Percent Complete indicator, 2) Generation log file "tailing", and 3) Generation Server Status.

Percent Complete is indicated in the pop-up dialogue presented once signal generation begins. The "Percent Complete" is computed in the RSS based on the progress through clutter iso-Doppler indexing in a burst, and the number of bursts generated. Within a single burst, the progress through iso-Dops tends to be quite non-linear, so progress will appear slow at the beginning of one coherent burst, and speed up near the end. Progress burst-to-burst tends to be linear and proportional to the number completed if the burst sizes are similar.

Generation Log File Tailing provides additional information on the progress of the RSS, and additionally provides immediate feedback of all informational, warning and error messages generated by the RSS. To tail the generation log file, type the command: *genlog*. This command is equivalent to the command:

```
tail -f ~spdmgr/log/rss_gen_status.log
```

Use Ctrl-C to stop this tailing process.

Generation Server Task Status may be obtained from any shell by executing the command: *genstatus*. This displays the current status of the Controller and RSS signal generation tasks. The script is in *~spdmgr/etc*.

3.2.7.2 Simulation Run Monitoring

Similar to signal generation, simulation run progress is monitored by observing the "Percent Complete" pop-up dialogue during signal processing.

Percent Complete in simulation run is updated with each NCI of detections received by the Testbed from the RSP. Within one NCI there is no update, so for example, a waveform having just 3 NCIs will be updated as: 33%, 67% and 100% on completion.

Simulation Run Task Status may be obtained from any shell by executing the command: *simstatus*. This displays the current status of the Controller and RSS Signal Playback and Simulation Run tasks. The Script is in *~spdmgr/etc*.

3.2.7.3 Trouble and Malfunction Indications

The following is a summary of observable trouble and malfunction indications of the SPD.

Information, Warning and Error Messages are generated by the SPD to alert the user to unusual conditions or fatal errors detected by the SPD software. SPD messages may appear inside an HMI dialogue as an "Alert" dialogue, a textual message in a dialogue, or may be written to a log file which the user can open and read using any Unix text file read method (e.g. *more, vi* or *OpenWindows Filemanager*). In the case of the RTSG, ESP and RSP units, SPD messages are also output to the serial port of the Executive Controller CPU, and will be displayed in a dumb terminal connected to that port.

Appendix F lists all SPD information, warning and error messages, organized by functional area and CSU name. All messages include identifications of the CSU in which the error was detected. Some of the messages from the Controller and RSS functional area include a time stamp.

Warnings and Error Messages for Other Applications are typically displayed from within the application (example: PVWaveCL syntax errors are reported at the Wave> prompt). Application errors may also be reported in the shell from which the application was run (example: PVWave Xlib errors). Similarly, Unix command line syntax errors are reported in the shell in which they are run, or sometimes may cause an error message to appear in the SunOS "Console" window. The SunOS console is normally one of the windows opened when OpenWindows is in use at either workstation console.

Core Dumps typically occur if an application program attempts to access an invalid region of memory, or an illegal instruction is detected by SunOS. A core dump is recognized when the application program fatally crashes, and a "core" file appears in the current directory. Repeated occurrences of a core dump usually indicates that a bug exists in the application.

Abnormal Behaviour occasionally results if an application program gets into an unexpected state, or the software environment (environment variables, etc.) becomes corrupted. It is difficult to classify all abnormal behaviour, but examples can include abnormal or no response to user mouse or keyboard events, or freezing of an application (indicated by the SunOS "stopwatch" icon meaning the application is busy).

3.2.8 Recovery Procedures

This section describes some procedures to recover from SPD errors or crashes. It provides some guidance on use, but is not a concise step-by-step procedure for every failure. The actions taken typically depend on the nature of the fault.

3.2.8.1 Restart Following an SPD Error or Crash

In the event of a fatal error (severity FATAL) or a crash of one or more SPD processes, the following should be done.

1. If signal generation hangs, crashes, or otherwise terminates abnormally, shut down, cleanup and restart the signal generation server tasks with the commands (must be done by SPDMGR user):

% genshdn	Shut down tasks (gracefully)
% genclean	Forced cleanup (kills all generation tasks)
% genstup	Start up signal generation servers.

2. If a simulation run hangs due to a RTSG, ESP or RSP fatal error, reset the affected unit and allow it to reboot.

3. If a simulation run has crashed due to either a RTSG, ESP or RSP error, or the Controller tasks are hung, shut down, cleanup and restart the simulation run server tasks with:

% simshdn	Shut down simulation server tasks (gracefully)
% simclean	Forced cleanup (kills all simulation run tasks)
% simstup	Start up simulation run server. (Do after DSP rebooting completed.)

4. Check for any "core" files and delete them. (Normally these are not needed unless one plans to use the SunOS debugger.)

5. Remove any partial intermediate results files. These files may have zero size, or be partially filled with data that is usually unrecoverable unless a run completes normally.

After *genstup* or *simstup* is done, check the server status with the commands *genstatus* or *simstatus*. All tasks should not be running. If so, then attempt to re-run the generation or simulation run activity.

If the RTSG, ESP or RSP report a fatal error or crash, it may be necessary to reset all three units together. The exact order is unimportant, but allow all units to reboot before attempting to restart the Simulation Run Server processes.

3.2.8.2 Other Problems

SPD Network

If rebooting the DSP and restarting the server tasks cannot be completed, or communication errors occur during a simulation run, check the physical connections of the RTSG, ESP and RSP to the SPD Ethernet LAN.

Other Network Connections

If the SPD is connected to an external network and remotely mounts any external servers, and problems occur with the servers, the workstations may become slow or unresponsive. This is usually related to NFS errors that are handled internally by SunOS. Either dismount or disconnect the external network, or wait for the external server to recover.

3.3 SPECIAL SPD USER ACCOUNTS

3.3.1 Configuration Manager User Account

A user account called SPDCM has been created for the Configuration Manager who is responsible for maintaining the CML database and conducting the SPD software release (fetching files from the CML database, compiling, linking and installing include files, libraries and executables). After the SPD is delivered, this account will contain the sources and executable SPD files.

The Configuration Manager defines the physical directories which contain the source code include files and libraries. There are a number of environment variables (logical directories) defined by the *~spdcm/.spdrc* file (SPD Resources Configuration file).

SPDINC	contains all SPD include files
SPDLIB	contains all SPD libraries
SPDBIN	contains all SPD executables.

The following environment variables are defined for the source directories at the functional area level:

SPDCOMN	directory containing the common software
SPDCTLR	directory containing the Controller software
SPDRSS	directory containing the RSS software
SPDESP	directory containing the ESP software
SPDRSP	directory containing the RSP software

A number of CSU subdirectories are created under these directories. Each CSU subdirectory contains source files (makefile, include files, C or assembly file). For example, the subdirectory of cdsi (Controller and DSP interface CSU; a common package used by both Controller and ESP/RSP) is located in $SPDCOMN/cdsi, however, the subdirectory of sbmt (Burst Modelling CSU) is located in $SPDRSS/sbmt since it belongs to the RSS software.

The *~spdcm/.spdrc* file is "sourced" automatically as part of the login procedure for each user. This defines the above environment variables for all users.

3.3.2 SPD Manager User Account

An SPD user account called SPDMGR exists for the SPD Manager or System Administrator who is responsible for startup/shutdown of SPD application servers, and to monitor the status of the SPD system. Normally the SPD Manager has the super-user privileges. However, the super-user privilege is suspended during the integration and testing phase.

There are a number of Unix environment variables which are configurable for the SPD applications at run time without recompiling and relinking the SPD software. These environment variables are defined in the *~spdmgr/.spdrc* file. This file is "sourced" as part of the default .login file.

The default values should be used unless the user wishes to customize the SPD environment for specific reasons. Section 3.1.2.5 lists SPD environment variables that may be customized by the user. Environment variables that normally should not be altered are listed in section 3.1.2.5.

3.4 X-WINDOW APPLICATION RESOURCES CUSTOMIZATION

Many of the SPD HMI characteristics are controlled by "X-window application resources" and can be customized by the user to alter the colour and appearance of the SPD dialogues. This section briefly outlines some of these control parameters.

The default SPD characteristics are defined by files in the directory referenced by the environment variable *XAPPLRESDIR* which is normally set to */home/spdctlr/spdmgr/xres*. This path is defined in the file *~spdmgr/.spdrc* which is automatically sourced on login.

To customize the X-window resources, copy these files to a user directory named *<username>/xres* and copy and alter the *.spdrc* file to set *XAPPLRESDIR* to this subdirectory.

Each HMI has its own resource file, identified as follows:

SatDef	Satellite/Radar Definition HMI
EnvDef	Environment Definition HMI
RunDef	Simulation Run Definition HMI
SigGen	Monitor/Control Signal Generation HMI
SimRun	Monitor/Control Simulation Run HMI

In each resource file, the following keywords are used to control HMI appearance:

foreground <colour>	Controls the foreground HMI colour
background <colour>	Controls the background HMI colour
topShadowColor	Top edge of a button
bottomShadowColor	Bottom edge of a button
highlightColor	Highlighted button colour
XmToggleButton.selectColor	Controls colour of a toggle button (exact parameter used depends on type of widget).
XmToggleButtonGadget.selectColor	Controls colour of a toggle button (exact parameter used depends on type of widget).
fontList	Controls font used in text in HMI.

Bit map files (**.bm*) are used for the graphical icons that appear in the environment HMI and should not be altered.

Also refer to the Sun OpenWindows initialization file (*.openwin-menu*) for customization of the appearance of windows.

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SECTION FOUR

DIAGNOSTIC FEATURES

This section describes the diagnostic features of SPD, and the procedures and tools used for diagnostic testing.

4.1 DIAGNOSTIC FEATURES SUMMARY

4.1.1 Operational Features

Diagnostic features of the SPD include the following operational features which provide information about the normal operation of the SPD, and can provide clues to isolating problems.

SPD Error Messages are used extensively throughout the DSP and Testbed to provide informational, warning, and error information about problems detected in the SPD software. SPD messages provide information about the location where the error was encountered, the severity, and an informational message which describes the problem, and may contain additional status/diagnostic data. Appendix E lists all the messages generated by the SPD.

DSP Features include visual indication of activity on the VASP boards and Executive Controller CPU, the Motorola OnCE port to each DSP96002 which can be accessed using the ADS, and a serial port to each CPU which can be connected to a terminal to monitor messages logged and access the VxWorks operating system on each CPU. It is also possible to access the Executive Controller CPUs from the workstation by remote login from a Unix shell.

Sun OS provides built-in error detection capabilities and diagnostic tools. If a Sun workstation fault is suspected, there is an extensive set of diagnostics provided by Sun Microsystems, called *SunDiag*, which can be used to isolate problems.

4.1.2 Diagnostic Procedures

Two principal diagnostic procedures are described in this section:

a. VASP stand-alone diagnostics using the ADS
b. VASP/VME diagnostics run in conjunction with the Executive Controller CPU.

For the remaining features, refer to third-party documentation as follows:

a. Sun Diagnostics (SunDiag) - see Sun MicroSystems documentation

b. Remote login to DSP CPUS - see VxWorks documentation on remote login, monitoring task status, etc.

c. VASP visual indicators - described in Spectrum Signal Processing documentation

d. Motorola CPU visual indicators - described in MVME167 documentation

4.2 VASP/ADS DIAGNOSTIC PROCEDURES

A set of VASP diagnostics exists which can be run using the ADS tool on the Controller Workstation. These tests are denoted the VASP/ADS tests, and may also be termed "stand-alone hardware" tests as they essentially test the VASP board in isolation. These tests do not require the DSP (or RTSG) unit be connected to any other unit, or network. Such connection does not preclude use of these tests, however, they should not be run if the DSP is being used to process data.

1. **Running VASP/ADS Tests.** First ensure that the ADS is connected to the workstation via its S-bus interface board. Connect the OnCE adaptor to a port on the IOP or GSP to place a single 96002 device under test. On the Controller workstation, open a Unix shell and *cd* to the directory *~spdcm/spdtools/vasp_diag*

   Three diagnostic groups are provided in the following subdirectories:

	Subdirectory
a. Signal Bus Interface (SBI) tests	*/test_sbi*
b. Synchronous Parallel Bus (SPB) tests	*/test_spb*
c. Two-Port Memory (TPM) tests	*/tpm_new*

   Choose the desired subdirectory and *cd* to it.

2. Start the ADS with the command:

   ```
   % ads96000
   ```

   This resets the ADS command converter and initializes the Unix window with the ADS command functions, and the ADS prompt *ADM0>*

3. Execute the desired VASP test by typing its name at the *ADMO* prompt. This retrieves and executes the corresponding **.cmd* macro file. For example, to run the SBI WRI, type the command *wri* at the prompt.

4. Follow instructions displayed by command file for any test-specific information. Test results are generally held in registers. For TPM tests, which run in an infinite loop, use the "force break" (*f b*) command to stop the test. Other tests run to completion or until an error occurs.

5. Examine registers and memory to determine test results, as explained below for each group of tests. To dump all 96002 registers, use the display (*d*) command without parameters. To display x or y memory, use the syntax:

   ```
   d x: <addr>
   d y: <addr>
   ```

   where *<addr>* is replaced by the hex address at which to begin display.

6. Repeat tests as desired or use quit (*q*) to exit the ADS window.

7. Test command files can be copied and edited as desired to change test mode or address range under test.

4.2.1 SBI Tests

The following SBI tests are provided. These exercise the interface between the 96002 processing element and the Signal Bus which connects to a TPM.

WRI:	IOP write to selected TPM address using maximum loop count, i.e. semi-continuously.
WRG:	GSP write to selected TPM as above
RDI:	IOP read from selected TPM address (use in conjunction with WRI)
RDG:	GSP read from selected TPM address (use in conjunction with WRG)
ISINGLE:	Initializes IOP for single Signal Bus transfers
GSINGLE:	Initializes IOP for single Signal Bus transfers

IOP.INIT: Initializes IOP PE communications with ADS

GSP.INIT: Initialize GSP PE communications with ADS

WRI/WRG/RDI/RDG can be run on multiple PEs to the same memory location in TPM simultaneously. The VASP Signal Bus arbitration logic ensures that hardware conflicts are avoided.

The GSP test status is reported in the DSP96002 registers: *d4.1* is an error status in 2's complement notation, and *d6.1* is a completion status. They are interpreted as follows:

Table 4-1 SBI Test Status

Error Status (d4)		Completion Status (d6)	
0	success	0	OK
-1	range error	1	SPB config error
-2	parity error	2	SPB write error
-3	timeout	3	SPB read error
-4	queue full	4	SBI config error
-5	burst error	5	SBI write error
-6	burst cycle error	6	SBI read error

4.2.2 SPB Tests

Two test routines are provided for synchronous parallel bus testing on one or more IOP. The following are provided:

SPBWR: Tests data transfer from TPM to TPM via SPB and Write IOP

SPBRD: Used on receiving IOP in conjunction with SPBWR

SPDWR/SPBRD can be run from multiple IOPs in one chassis, or on two IOPs across chassis to verify inter-chassis data transfer. In one chassis, the source and destination can be to the same or separate TPMs.

The IOP test status is reported in the DSP96002 registers as follows:

d3.1 SPB status in 2's complement
d4.1 test completion status
d5.1 error status

These are interpreted as follows:

Table 4-2 SPB Test States

SPB Status (d3)		Completion (d4)		Error Status (d5)	
1	busy	0	OK	0	success
0	idle	1	SPB config error	-1	range error
-1	range error	2	SPB write error	-2	parity error
-2	no clock	3	SPB read error	-3	timeout
-3	not config	4	SBI config error	-4	queue full
-4	overrun	5	SBI write error	-5	burst error
-5	illegal call	6	SBI read error	-6	burst cycle error

4.2.3 TPM Tests

Two-port memory testing is performed from an IOP or GSP PE. These tests perform more extensive exercising of the interface between a PE and TPM, and also the functionality of the memory. The following are provided (also refer to the related **.cmd* files for further explanation):

Test Procedure and Test Configuration Command Files

A set of command files (filenames **_gsp_*.cmd, *_ios_*.cmd)* are used to initialize and load the test software for the IOP or GSP and call the indicated test parameter file. These command files are edited by the user to test the desired TPM and select the test mode. The associated **_test_*.cmd* command files contain the test configuration including TPM address block, data mode (pattern), test mode (use 3: continuous burst, or A: walking bit, only), test pattern variables for increment and alternating patterns. The following are provided:

Table 4-3 TPM Test Status

GSP or IOP Test Procedure Commands	Test Configuration File	Function
w_gsp_1a.cmd	w_test_1a.cmd	Perform walking bit test on TPM from GSP
b_gsp_1_1a.cmd	b_test_1_1a.cmd	Continuous mode burst test (GSP)
a_gsp_1_1a.cmd	a_test_1_1a.cmd	Continuous mode burst test (GSP)
a_ios_1_1a.cmd	a_test_1_1a.cmd	Continuous mode burst test (IOP)
iint_1a.cmd	n/a	Test interrupt operation for IOP on Signal Bus 1
gint1_2_1a.cmd	n/a	Test interrupt operation for PE1 on Signal Bus 2

4.3 VASP/VME DIAGNOSTIC PROCEDURES

In addition to the VASP/ADS diagnostic procedures, a set of procedures exist to test VASP boards in conjunction with the Executive Controller CPU in one equipment unit. These tests may be either run from a terminal connected to the EC CPU serial port, or by remote login to the EC from the workstation. The unit must be connected to the SPD LAN to run these tests. The test routines are stored in a directory for each unit as follows:

~vaicm/rtshtest
~vaicm/esptest
~vaicm/rsptest

To run these tests:

1. Power-up unit and allow CPU to boot up, and wait for the -> prompt on the terminal connected. If the workstation is being used, remote login to the unit from a command window or Xterm window to get the prompt with the Unix command:

   where *rlogin <CPU hostname>*

   where *<CPU hostname>* is the name of the desired CPU (see Table 5-5).

2. To initialize the tests for the RSP, type the command: *<rspdrv.cmd*

   Note that the "<" is part of the command. This executes a start-up script and the CPU will respond with module and task information. The command for the ESP is *<espdrv.cmd*, and for the RTSG: *<rtsgdrv.cmd*

3. At the -> prompt, enter the command: *testVAI* and the unit should respond with the VASP Driver Testing menu. Select "1" and then "2" to configure. Then select the desired test 3 - 6 inclusive, or 9 - 12 inclusive. Tests 7 and 8 require reset after running. Tests 13 - 17 require special preparations and should not be used.

The following VASP/VME test commands are provided:

0 Exit
1 Driver install and device configuration
2 Open device and download executable
3 Transfer data from host to PE using Data Service Request (DSR)
4 Transfer data from PE to host using DSR
5 Perform error service request (PE reporting error to host)
6 Perform signal service request (PE requires service from host)
7 Close PEs (terminate any executable running on a PE)
8 Reset subassembly
9 Transfer data from host to PE using Programmed I/O (PIO)
10 Transfer data from PE to host using PIO
11 Transfer data from host to PE using Direct Memory Access (DMA)
12 Transfer data from PE to host using DMA

4.4 DIAGNOSTIC TOOLS

Two hardware diagnostic tools are furnished with the SPD, and may be used for detailed debugging, testing and trouble-shooting. These are:

- Motorola 96002 Application Development System (ADS)
- Motorola MVME16xBUG EPROM Debugger (non-resident).

> CAUTION !
>
> When troubleshooting any SPD hardware (e.g., handling ADS OnCE connector, or removing/inserting VME cards), precautions should be taken to prevent damage from static discharge. Wear a static discharging wristband and use a grounded conductive work surface (e.g., conductive rubber mats).

4.4.1 ADS

The Motorola 96002 ADS is used for VASP/ADS diagnostics described above in Section 4.2, and for PE software testing and debugging. The ADS consists of an interface card to the Controller workstation S-Bus, and a "Command Converter" adaptor board. The ADS may also be hosted by the RSS workstation. The outboard end of the ADS command converter is a multi-conductor plug which connects to the OnCE connector for each 96002, provided on the front plenum of each IOP and GSP. An IOP has one PE OnCE port, and a GSP board has four PE OnCE connectors. For further information on the ADS, refer to the Motorola ADS manual, R-14.

The ADS can be used to download and run PE software, and to execute macros from the host.

Debugging Multiple PEs

One ADS can be used to test or debug multiple PEs provided one important condition is met: when switching between PEs, they must be in the same debug state (i.e., running after a Go command executed, or halted with a Force Break command). The OnCe connector can be safely unplugged and moved from one PE to another while running or halted, provided usual precautions (see Caution above) are taken to prevent static discharge.

The ADS includes the following functions:

- Load (executable software from host);
- Run ;
- Break;
- Step;
- Display/modify 96002 memory and registers;
- Assembly/disassembly of code.

4.4.2 MVME16xBUG

The MVME16xBUG is an EPROM based debugger for Executive Controller (MVME167) CPU software debugging and testing. It allows testing of CPU memory, peripherals and change of configuration memory. The debugger is non-resident in the SPD VASP CPUs - to use it requires replacing the VxWorks EPROMS with the MVME16xBUG EPROMs. For further information, refer to the Motorola Debugging Package (R-15).

SECTION FIVE

MAINTENANCE

This section describes physical maintenance items for the SPD.

5.1 MAINTENANCE CONCEPT

This section describes the maintenance and support concept for the SPD. From a supportability point of view, the SPD hardware is characterized by the following:

a. **Modular Design.** The system configuration lends itself to maintenance by removal and replacement. This minimizes the need for special tools and test equipment and personnel skills.

b. **Availability of Vendor Support.** Commercial, off-the-shelf items are used in the SPD and are fully supported by the original equipment manufacturer.

c. **Diagnostics.** The SPD is supplied with an extensive diagnostics package to minimize fault detection and isolation times.

The equipment is supported by a combination operator and contractor maintenance. The operator will perform routine preventive maintenance.

5.2 PREVENTIVE MAINTENANCE

Recommended preventive maintenance activities, and frequency of activity, are summarized in Table 5-1.

Table 5-1 Preventive Maintenance Activities

#	Maintenance Activity	Frequency	Consumables	Tools	Procedure
1	Vacuum Air Filters	Monthly		Vacuum	See Table 5-2
2	Wash Air Filters	6 monthly	Mild detergent	Common hand tools	See Table 5-2
3	Clean the 8 mm Tape Drive	Occasionally	Cleaning tape	None	Desktop Storage Module Installation Guide
4	Clean the tape drive	8 hrs tape operation	Cleaning swab	None	Sun Tutorial on 1/4" drive
5	Cleaning Compact Disc	Occasional	Soft, lint-free, dry cloth	None	Desktop storage pack
6	Replace Toner	As required	Toner cartridge	None	Sparc printer Installation and User's Guide
7	Clean Monitor	Monthly	Lint-free cloth isopropyl alcohol	None	See Table 5-2
8	Clean Workstations	Annually	Lint-free cloth, mild detergent	None	See Table 5-2

Table 5-2 lists recommended steps for routine cleaning of SPD components.

Table 5-2 Recommended Preventive Maintenance Procedures

	Procedure
Vacuum Air Filters	Vacuum dust collected on air filters at the rear of the RTSG, ESP and RSP equipment units.
Washing Air Filters	Remove air filters from rear of RTSG, ESP and RSP and wash in mild detergent. Less frequent than vacuuming.
Clean Workstation Displays	Power down display monitor to avoid static discharge. Wipe off accumulated dust with clean lint-free cloth. Remove fingerprints with isopropyl alcohol wipes.
Clean Workstation and Chassis Exterior Surfaces, and Keyboards	Vacuum or wipe with lint-free cloth accumulated dust rom surfaces. Clean keyboards using cloth dampened with mild detergent or window cleaning solution. Do not spray cleaning solution directly onto keyboards.

5.3 CORRECTIVE MAINTENANCE

Both hardware and software corrective maintenance is contracted. Table 5-3 lists the principal hardware items and vendors, and Table 5-4 lists the principal third-party software items. A detailed list of SPD items, along with vendor address and telephone numbers, are provided in the SPD Description Report, Section 7.3.

Table 5-3 Hardware Suppliers

Hardware Item	Vendor
Workstations, disk drives, tape, CD-ROM, printer	Sun Microsystems Canada
VASP: TPM, GSP and IOP boards	Spectrum Signal Processing
DSP, RTSG: MVME167 CPU board	Motorola
RSS Coprocessor	CSPI, Inc.
Note: At time of SPD installation, there are no hardware maintenance contracts remaining in effect.	

Table 5-4 Third Party Software Suppliers

Software Item and Version	Vendor
SunOS 4.1.3, Open Windows 3.0, NeWS print Vers. 2.0	Sun Microsystems Canada
PVWave Command Language 4.0, Point and Click 2.2, VIM/x2.0	Visual Numerics Inc., Boulder, CO
OSF/Motif 1.1.04(A)	IXI Ltd.
VxWorks 5.1, Gnu Toolkit V 1.37, VxGDB 1.0.2	Wind River Systems
Intermetrics 96002 C Compiler, V 1.2.1, Intertools	Intermetrics, Inc.
96002 ADS Software, Vers. 4.1.2	Motorola
Coprocessor i860 cross-compiler and run-time library Vers. 4.1.2, S-Bus driver V.401a	CSPI
Gnu C Compiler for Sun4, V.2.3.3, GDB Vers. 4.7	Gnu (Public Domain)
X11 Libraries (x11R5) CD-ROM	Walnut Creek CD-ROM
Note: At time of SPD installation, there is only one software maintenance contract remaining in effect, PVWave CL & PC, which expires December 2, 1994. Site ID = MACDET02.	

5.4 CONFIGURATION DATA

The following table lists some configuration data which may be required for software maintenance and support.

Table 5-5 Configuration Data

Parameter	Value
IP Address (SPD Controller)	131.136.37.10
Testbed Controller Workstation Host ID	726059E1
RSS Workstation Host ID	726085E2
PVWave Site IDs:	
a. CL & PC (installed on TB Controller at MacDonald Dettwiler)	MACDET02
b. CL only, installed on RSS	RAYCA01
Testbed Controller Hostname	spdctlr
RSS Workstation Hostname	sdprss
RTSG CPU Hostname	spdrtsg
ESP CPU Hostname	spdesp
RSP CPU Hostname	spdrsp

5.5 MAINTENANCE REFERENCES

8 mm Tape Drive (R-16):

"Desktop Storage Module Installation Guide"
Sun Document #800-7235-10
Rev. A, May 1992
Sun Microsystems Inc.

QIC-150 1/4" tape (R-17):

"Sun Tutorial on 1/4-Inch Tape Drives"
Sun Document #800-1315-05
Rev. A, May 1989
Sun Microsystems Inc.

SECTION SIX

NOTES

This section contains a list of acronyms, abbreviations, and glossary of technical terms.

6.1 ACRONYMS AND ABBREVIATIONS

This list includes all acronyms used in the SPD dialogue boxes and messages, as well as this operator's manual for reference.

AC	Alternating Current
A/D	Analogue-to-Digital
ADS	Application Development System
AES	Application Environmental Specification
ANSI	American National Standards Institute
ASAR	Arrested Synthetic Aperture Radar
ASB	Antenna Sidelobe Blanking
AUX	Auxiliary
Ax	Auxiliary
AWG	American Wire Guage
BSL	Build Standard List
CA	Cell-Averaging
CC	Clutter Cancellation
CCIR	International Consultative Committee for Radio
CD	Compact Disk
CD	Contract Deliverable
CDADL	C-based Design and Documentation Language
CDR	Critical Design Review
CD-ROM	Compact Disk Read-only Memory

CFA	Corporate Fed Array
CFAR	Constant False Alarm Rate
CFM	Cubic Feet per Minute
CLCC	Ceramic Leaded Chip Carrier
CLR	Controller (Functional Area)
cm	centimetre
CML	Configuration Management Library
COTS	Commercial Off-The-Shelf
CPI	Coherent Processing Interval
CP	Coherent Processing
CPU	Central Processing Unit
CR	Change Record
CRT	Chinese Remainder Theorem
CSA	Canadian Standards Association
CSCI	Computer Software Configuration Item
CSOM	Computer Software Operator's Manual
CSC	Computer Software Component
CSCI	Computer Software Configuration Item
CSPI	CSPI, Inc. (manufacturer of co-processor)
CSU	Computer Software Unit
CTI	Contiguous Time Interval
CW	Continuous Wave
DARTS	Design Approach for Real Time Systems
dB	decibel
dBm	decibels relative to one milliwatt
dBm^2	decibels relative to one square metre (unit of RCS)
dBw	decibels relative to one watt
DC	Direct Current
deg	degree (angle or temperature)
DFD	Data Flow Diagram
DI	Dwell Interval
DIP	Dual In-Line Package
DND	Department of National Defence
DOC	Department of Communications
DOF	Degree of Freedom
DPCA	Displaced Phase Centre Antenna
DRAM	Dynamic Random Access Memory
DREO	Defence Research Establishment Ottawa
DSP	Digital Signal Processor
DT	Detection Thresholding
EC	Executive Controller
ECCM	Electronic Counter-countermeasures
EIA	Electrical Industries Association
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EPROM	Erasable Programmable Read-only Memory

ERP	Effective Radiated Power
ESP	ECCM Signal Processor
FA	Frequency Alignment
FCC	Federal Communications Commission
FFT	Fast Fourier Transform
FLOP	Floating-Point Operation
FM	Frequency Modulation
FPGA	Field Programmable Gate Array
G	Giga (10^9)
GB	Gigabyte
GHz	Gigahertz
GMT	Greenwich Mean Time
GND	Ground
GSP	General Signal Processor
GUI	Graphical User Interface
H	Horizontal (polarization type)
HMI	Human-Machine Interface
HW	Hardware
HWCI	Hardware Configuration Item
I	In-Phase (real part of a complex signal)
ID	Identification
IEEE	Institute of Electrical and Electronics Engineers
IF	Intermediate Frequency
I/F	Interface
IOP	Input/Output Processor
IP	Internet Protcol
IPC	Interprocessor Communication
ISDN	Integrated Services Digital Network
ISSPL	Industry-standard Signal Processing Library
J	*No acronyms start with J*
k	kilo (10^3)
kB	kilobyte
kB/s	kilobytes/second
kg	kilogram
km	kilometre
LAN	Local Area Network
LED	Light Emitting Diode
LFM	Linear Frequency Modulation
LSB	Least Significant Bit
m	metre

M	Mega (10^6)
MASR	Multiple Antenna Surveillance Radar
MB	Megabyte
MB/s	Megabytes/second
MDA	MacDonald Dettwiler and Associates
MFLOPS	Million Floating-Point Operations Per Second
MHz	Megahertz
mm	millimetre
ms	millisecond
MTBF	Mean Time Between Failures
MTI	Moving Target Indication
N/A	Not Applicable
NCI	Non-Coherent Integration
NEMA	National Electrical Manufacturer's Association
NFS	Network File System
NLFM	Non-Linear Frequency Modulation
NRE	Non Range Eclipsing
ns	nanosecond
OnCe	On-chip Emulation
OS	Operating System
OS	Ordered Statistic
PC	Phase Centre
PC	Pulse Compression
PD	Pulse Doppler
P_d	Probability of Detection
PDL	Program Design Language
PDR	Preliminary Design Review
PE	Parameter Estimation
PE	Processing Element
PESS	Processing Element Support Software
PFA	Probability of False Alarm
P_{fa}	Probability of False Alarm
PMC	Platform Motion Compensation
PRF	Pulse Repetition Frequency
PRI	Pulse Repetition Interval
Q	Quadrature (imaginary part of a complex signal)
QPM	Quadrature Phase Modulation
RAR	Range Ambiguity Resolution
RCL	Raytheon Canada Ltd.
RCS	Radar Cross Section
RE	Range Eclipsing
RFI	Radio Frequency Interference
RH	Relative Humidity

R-Matrix	Auxiliary Covariance Matrix
RMS	Root Mean Square
RPC	Remote Procedure Call
RRA	Rotating Reflector Antenna
RSP	Radar Signal Processor
RSS	Radar Signal Simulator
RTSG	Real-Time Signal Generator
RTVM	Requirements Traceability and Verification Matrix
r-vector	Auxiliary-"main" correlation vector
RX	Receiver
s	second
SA	Sampling Alignment
SBI	Signal Bus Interface
SBR	Space-Based Radar
SC	Sampling Correction
SCSI	Small Computer Systems Interface
SCR	System (or Software) Change Request
SDR	System Design Review
SNR	Signal to Noise Ratio
SOW	Statement of Work
SPB	Synchronous Parallel Bus
SPD	Signal Processing Demonstrator
SQR	System Qualification Review
SRSD	Simulated Radar Signal Data
SSP	Sub-Satellite Point
S/W	Software
TB	Testbed
TBC	To Be Confirmed
TBD	To Be Determined
TCP	Transmission Control Protocol
TM	Trimmed Mean
TPM	Two Port Memory
TRWC	Target Range Walk Compensation
TTY	Teletype
TVPT	Time-Varying Parameters Table
Tx	Transmitter
UL	Underwriters Laboratories, Inc.
U-Matrix	Cholesky factor matrix (adaptive nulling)
V	Vertical (polarization type)
V	Volt
VA	Velocity Alignment
VAC	Volts Alternating Current
VAI	VASP Application Interface
VASP	Versatile Array Signal Processor

VME	Versa Module European
W	Watt
WV	Weight Vector
XDR	eXternal Data Representation
Y	*No acronyms start with Y*
z-vector	Forward elimination result (adaptive nulling)

6.2 GLOSSARY OF TERMS

The following is a glossary of technical terms having particular meaning or usage in this Operator's Manual or in the SPD HMIs. Technical radar terms are not included if they are widely understood.

Beamwidth. Beamwidth is the linear angle that spans between the -3 dB power points of the one-way antenna pattern. In the RRA concept, the minimum data segment size is defined in terms of the sweep duration of the beam.

Blanking. The process of suppressing unwanted jammer signals in the main radar channels by comparing main and auxiliary channel signals, and zeroing the signal when jamming is detected.

Bootstrapping. The process by which computers in the system self-start after power is applied. Also shortened to "booting up".

Burst. A burst is a sequence of coherent pulses at one pulse repetition frequency (PRF) and one transmit frequency. It is also known as a Coherent Processing Interval (CPI) since phase information is processed over the interval of one burst.

Coherent Processing Interval. The interval over which coherent pulse Doppler processing is performed. The number of pulses coherently processed is less than or equal to the number transmitted.

Coherent Sector Blanking. Also known as post Doppler blanking or range Doppler blanking, this refers to blanking performed after pulse Doppler and pulse compression processing to remove coherent jammers (e.g., false targets from deception type jammers).

Contiguous Time Interval. Refers to a single uninterrupted interval of satellite time over which radar data is generated, played back and processed.

Data Segment. A data segment is one contiguous time interval of satellite data that is precomputed, stored, and processed by the SPD.

Dialogue. Refers to user interaction with the Graphical User Interface (GUI). A "dialogue box" is one window containing related processing or control parameters.

Dwell. A dwell is one or more bursts that are directed towards one area of the ground over one contiguous segment of orbit time to perform a detection. In the SPD, a dwell interval consists of one or more NCIs with one or more burst/NCI. Multiple NCIs with differing PRFs are used to provide unambiguous target range estimates in one dwell.

Functional Area. A functional area is the second level of decomposition of a system. Each subsystem in the SPD consists of two functional areas. The DSP subsystem consists of the ECCM Signal Processor (ESP) and Radar Signal Processor (RSP) functional areas, and the Testbed subsystem consists of the Testbed Controller and Radar signal Simulator functional areas.

Iteration. An iteration is one repetition of the data segment for playback and processing. A simulation run may consist of one or more iterations without changes in processing parameters. Multiple iterations are used to demonstrate average DSP throughput performance for a particular signal and algorithm configuration.

Launch. Refers to starting up a software program on the workstation by either double-clicking on the application's executable icon, or by invoking the program at the command line prompt.

License Manager. A program which runs on the workstation to provide controlled access to purchased third party software. The license manager may restrict the number of users who can simultaneously access and run the program.

Parameter Validation. Refers to logic which cross-checks user-entered data against known constraints. The SPD provides two levels of validation: 1) "HMI validation" one in the limits of individually entered values, and 2) "CVAL validation" which performs consistency checking between parameters to ensure physical and operational constraints are satisfied.

Post-Doppler Blanking. See Coherent Sector Blanking.

Pulse. A pulse is the transmission of one gated modulated microwave signal by the radar.

Range-Doppler Blanking. See Coherent Sector Blanking.

Range Line. In the signal processor, one range line refers to the radar signal samples in one PRI.

Signal Generation. Signal generation is the process of computing a Simulated Radar Signal Data (SRSD) file based on a selected Satellite/Radar Definition and Environment Definition file. The SRSD file is computed on the RSS workstation.

Simulation Run. A simulation run is the playback of one or more iterations of a data segment through the signal processor, in response to an operator request. One "run" takes a simulated radar signal data file and DSP processing parameter file, and generates detection data and intermediate results.

Slider Bar. An element of a HMI dialogue that allows the user to enter or change a numeric value analogous to a mechanical slider bar.

Subsystem. A subsystem is the first level of decomposition of a system. The SPD consists of two subsystems: the DSP subsystem and the Testbed subsystem.

Widget. A software term for the element of the HMI which is used to enter data. Examples of widgets are: slider bar and radio buttons.

APPENDIX A

HMI CONVENTIONS AND UTILITY DIALOGUES

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APPENDIX A

HMI CONVENTIONS AND UTILITY DIALOGUES

Appendices A-E describe the SBR SPD Human-Machine Interface (HMI) dialogues. They are organized as follows:

Appendix A: SPD HMI Conventions and Utililty Dialogues
Appendix B: Satellite/Radar Definition
Appendix C: Environment Definition
Appendix D: Simulation Run Definition
Appendix E: Monitor/Control Signal Generation and Monitor/Control Simulation Run

The Satellite/Radar Definition and Environment Definition together define a SBR simulation scenario to generate a Simulated Radar Signal Data (SRSD) file. The Simulation Run definition determines how the signals will be processed in the DSP when a "run" is executed.

These appendices were derived from Appendix G, "HMI Dialogue Design", in the Testbed Detailed Design, and have been revised with actual implementation details and description of parameters based on the HMI Parameter Table in Appendix A of the Testbed Specification. This first appendix describes features and characteristics common to all SPD HMIs.

A1. HMI CONVENTIONS

A1.1 Windows and Dialogues

The graphical HMI is based on the OSF/Motif style of graphical computer interface, which in turn, is built on top of the windows environment provided by Sun OpenWindows. A "window" refers to one framed area on the computer workstation screen in which text or graphical information can be written. The OpenWindows environment allows many types of windows to be displayed including "command shells" which accept Unix/Sun OS command line input, a variety of Sun tools such as FileManager, Printtool, Mailtool, etc., and the windows specific to the SPD. A "dialogue" refers to a window opened within an SPD HMI to enter information into a definition file, or to control and monitor signal generation, or playback and processing activities.

A1.2 Conventions

The following summarizes some of the conventions used specifically to the SPD HMIs. The overall approach and standards used in designing the HMI dialogues are described in Appendix A of the Testbed Preliminary Design Document (Document R-13). The Open Software Foundation (OSF) Motif Widget set, and the Motif style and widget behaviour, used to build the HMI dialogues are described further in OSF documentation (Documents R-18, 19, 20, 21).

A1.2.1 Dialogue Action Buttons

The following push buttons are common to most dialogues and are used to complete or cancel an editing operation.

Button	**Action**
OK	Apply the changes made in the dialogue box to the *in-memory data* structure, close, and exit this window.
Cancel	Do not apply any changes that may have been made in this dialogue to the in-memory data structure, close, and exit this window.
Apply	Apply the changes made in this dialogue box to the in-memory data structure, and do not exit this dialogue. This button appears in some of the dialogues only.

A1.2.2 Latitude/Longitude Entry

A customized latitude/longitude widget provides input of latitude, longitude, azimuth angle, or attitude angles in degrees, minutes and seconds using ddd:mm:ss format. The following conventions are followed:

Range of latitude:	-90:00:00 (South) to 90:00:00 (North)
Range of Longitude	-180:00:00 (West) to 180:00:00 (East)

- Clicking page increment/decrement steps value by +/- 1 minute

- Clicking increment/decrement button (left and right arrows at ends of slider) changes value by +/- 1 second.

- Numerical value may also be typed directly into the text field by selecting the field (by double clicking on the value) then entering a new value. The current value may also be character edited by positioning the mouse pointer, and single clicking to get the "I-beam" edit cursor.

A1.2.3 Numerical Data Entry

A customized numerical scale widget is also provided with similar behaviour to the latitude/longitude widget. It consists of a text label, a slider bar and numerical field. The numerical value displayed and the slider bar indicates the value within the valid range set for that parameter. The slider bar may be used in three ways: 1) dragging the slider indicator directly changes the value over the full range; 2) clicking the slider bar (page increment/decrement) gives a coarse change, and 3) clicking the increment/decrement button arrows gives a fine change. The coarse and fine change depend on the particular parameter.

A1.2.4 Channel Acronyms

A "channel acronym" is used to identify the main and auxiliary channels in the HMIs for nulling and blanker selection. The channel acronym uses the following convention:

- Main antenna phase centres:

RRA case:	P1 (RRA case - only one phase centre)
CFA case:	P1 P2 P3 (group 1) P1 P2 P3 (group 2)

- Auxiliary A1 A2 A3 ... A16 (maximum of 16 auxiliaries)

- Delay tap: T1 T2 T3 (max. 3 taps for a given aux.)

For example, two-group, two-phase center per group CFA with four auxiliaries and taps could be organized as follows:

DPCA Group 1	DPCA Group 2	Aux. 1 (3 taps)	Aux. 2 (1 tap)	Aux. 3 (no taps)	Aux. 4 (2 taps)
P1 P2	P1 P2	A1 T1 T2 T3	A2 T1	A3	A4 T1 T2

This example contains a total of 14 signal channels. A maximum of 22 is allowed.

A1.2.5 Channel Identifier

A numerical "channel identifier" or "channel ID" is also used throughout the SPD to uniquely identify main phase centres and auxiliary channels. The channel identifer starts from 1 for the first main phase centre, and counts upward, in order of main phase centre groups, followed by auxiliaries and tap delay channels. Each auxiliary and its own taps are numbered consecutively before the next auxiliary. For the example above, the corresponding channel identifiers would be as follows:

DPCA Group 1	DPCA Group 2	Aux. 1 (3 taps)	Aux. 2 (1 tap)	Aux. 3 (no taps)	Aux. 4 (2 taps)
1 2	3 4	5 6 7 8	9 10	11	12 13 14

A1.2.6 Button Grids

Some dialogues use rows, columns, or 2-dimensional grids of "buttons" to allow selection of more than one item at a time. These buttons are distinguished by a square shape with shading that gives the appearance of having relief. Toggling the button with the left mouse button changes the state of the button. The convention is:

- Button "On": "pressed in": centre "filled" or darkened: item selected
- Button "Off": "not pressed": centre light coloured: item not selected.

A1.2.7 Radio Buttons

A radio button grid is a 1-dimensional grid of buttons that only allows one button to be selected at a time, forcing a choice of several exclusive items. Radio buttons are distinguished from regular buttons by their diamond shape.

A1.2.8 Filename Text Fields

Filename selection in the signal generation and simulation run dialogues is performed by pressing the small button immediately to the left of the filename text field. A file selection dialogue box will then pop-up to allow the user to choose a file. The user is not permitted to edit the filename text field directly; it is used for display only of the current filename. See also A2.2 "File Selection Dialogue" below.

A1.3 Implementation Rules and Structural Dependency

The SPD HMIs enforce certain dependencies between parameters defined in the dialogues. The following lists these dependencies and their implementation.

a. Parameters that are not relevant to the particular configuration are ghosted out. A value may be indicated but cannot be edited by the user.

b. Smart ranges are used in certain widgets to enforce a valid range of that parameter which depends on another parameter. An example is the selection of auxiliary antenna characteristics; the choice is limited to the number of auxiliaries defined in Channel Selections.

c. Default parameter values (those which are set up when a new definition is initialized) are generally fixed, with the exception of those which are dependent only on the Concept (CFA, RRA) parameter. In that case, the defaults are set according to which SBR concept is selected.

d. In a numerical text field, if direct entry of a value out of range is attempted, the value will be set to the nearest range limit. If an invalid numerical value is detected (e.g. entering non-numeric characters), the previous numeric value will be retained.

A2. UTILITY DIALOGUES

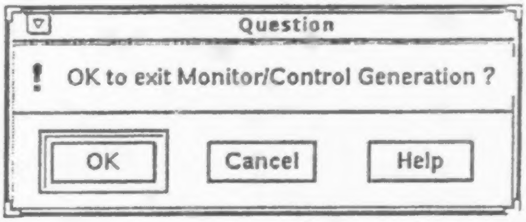
These are the common dialogue boxes which are used throughout the SPD HMI. They are also termed "pop-up" as they appear in response to a specific user action, typically to confirm or complete an operation, or prompt for further information. After the user responds, the dialogue disappears.

A2.1 Confirmation Dialogue

The confirmation dialogue is used to get confirmation from the user before proceeding with an operation. The confirmation dialogue "blocks" the user from any other interaction with the related application until the confirmation question is answered. The confirmation is used in the following cases:

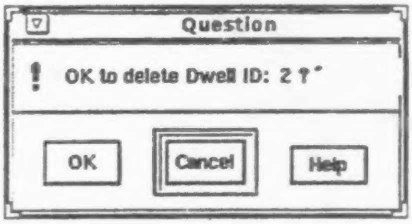
- exiting an application
- changing radar concept
- deleting sub-intervals (dwells, NCIs, CPIs)
- reporting warnings or error messages
- proceeding with signal generation or simulation run after validation errors found

Pressing "OK" causes the action to proceed; "Cancel" cancels the action and returns to the previous dialogue; pressing "Help" gives further information about the question being asked.



OK to exit Monitor/Control Generation ?

(a) Exiting HMI



OK to delete Dwell ID: 2 ?

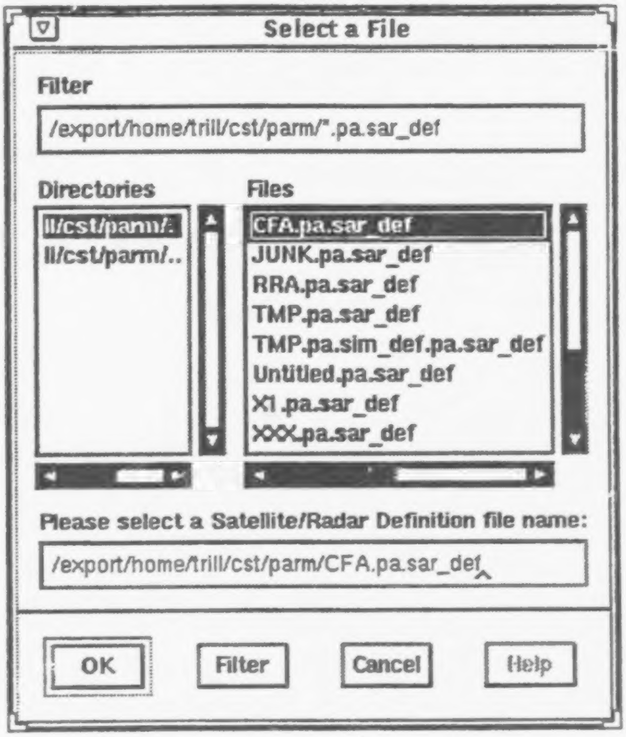
(b) Deleting a Waveform Interval

Figure A-1 Confirmation Dialogues

A2.2 File Selection Dialogue

This dialogue box is used to select a directory and file in response to an SPD action which requires a filename to continue. This dialogue used in "Open" and "Save As" operations, and appears in response to clicking on a file selection icon (the small button immediately left of a filename text field). This dialogue allows the user to traverse through directories in the file system using double-click on the directories listed, and to select a file under the list presented. A filename is selected using the mouse pointer and left mouse button, and then pressing "OK". A short-cut to "OK" is to double-click on the filename, which will select that file and exit the dialogue immediately. Similarly, directories can be changed by selecting or double-clicking on a directory name. Unix path conventions are used; e.g. to move up one level in the directories, select the directory ending in double-dot (".."). To move down one level, double-click the directory name in the list.

The "Filter" text field is used to filter and display only filenames matching the specified pattern, and is typically used to limit display to files containing a specific definition type or data. The filter name may contain one or more wildcard characters (*) in the directory portion, file portion, or both. All files or directories that match the filter mask will be displayed when the user activates the "Filter" button. In the example below, only files that match the pattern **.pa.sar_def* (the extension used to indicate a Satellite/Radar Definition file) are displayed.



/export/home/trill/cst/parm/*.pa.sar_def

ll/cst/parm/.
ll/cst/parm/..

CFA.pa.sar_def
JUNK.pa.sar_def
RRA.pa.sar_def
TMP.pa.sar_def
TMP.pa.sim_def.pa.sar_def
Untitled.pa.sar_def
X1.pa.sar_def
XXX.pa.sar_def

Please select a Satellite/Radar Definition file name:

/export/home/trill/cst/parm/CFA.pa.sar_def

Figure A-2 Select File Dialogue

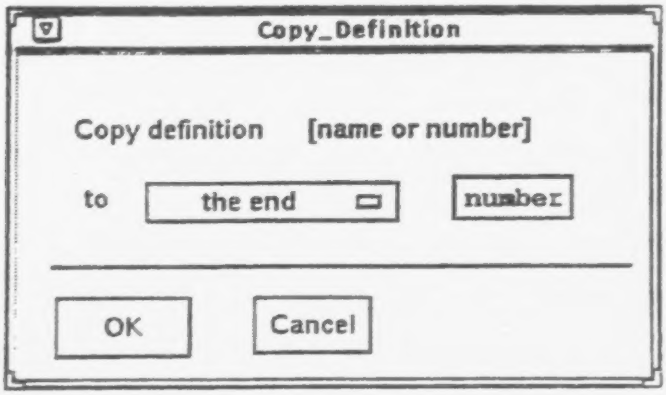
A2.3 Copy Dialogue

This dialogue is used to copy an interval definition (dwell, NCI, CPI) in the Satellite/Radar Definition HMI. It is activated from the menu bar by selecting Create -> Copy Interval -> Dwell, NCI, CPI. The selected definition, indicated by the radio buttons for dwell, NCI and CPI becomes the source of the interval to be copied, and the destination is selected in this dialogue to be "the end", "the beginning", or "before position".

The default destination is to "the end", meaning that the current interval definition is copied to follow the last interval defined for that level. The "number" field in this case is display-only and indicates the new interval number that will be added. For example, if a "Copy Dwell" operation is selected and there are 10 DIs defined, then the new dwell will be numbered "11".

When copy to "the beginning" is selected, a "1" is displayed indicating that the new copied interval will become the first one. The current interval is copied to the first position, and the remaining intervals are renumbered to one higher value.

If copy to "before position" is selected, the current interval will be copied and inserted in advance of the one indicated by "number". The remaining intervals are then renumbered higher by one. For example, if the current CPI is 5 out of a total of 10, and "Copy CPI" to "before 9" is selected, then the 9th CPI will become a copy of CPI 5, and the previous CPI 9 and 10 will be renumbered to 10 and 11.



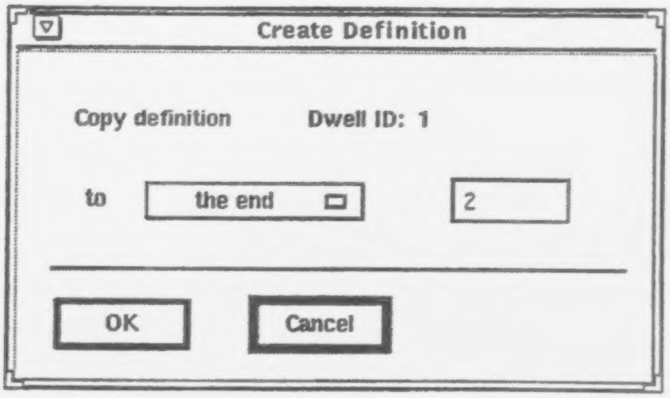
Copy definition [name or number]

to the end number

Figure A-3 Copy Definition Dialogue

A2.4 Create Dialogue

This dialogue is used to create a new interval (dwell, NCI or CPI) definition in the Satellite/Radar Definition HMI. It is activated by selecting Create -> New Interval -> ... from the menu bar. It operates in the same way as a "Copy Interval", and allows a new interval to be added to the end, inserted at the beginning or before a specified interval. It operates in the same way as Copy Interval, except the new interval is initialized with default values for the selected SBR concept.



Copy definition Dwell ID: 1

to the end 2

Figure A-4 Create Definition Dialogue

APPENDIX B

SATELLITE/RADAR HMI

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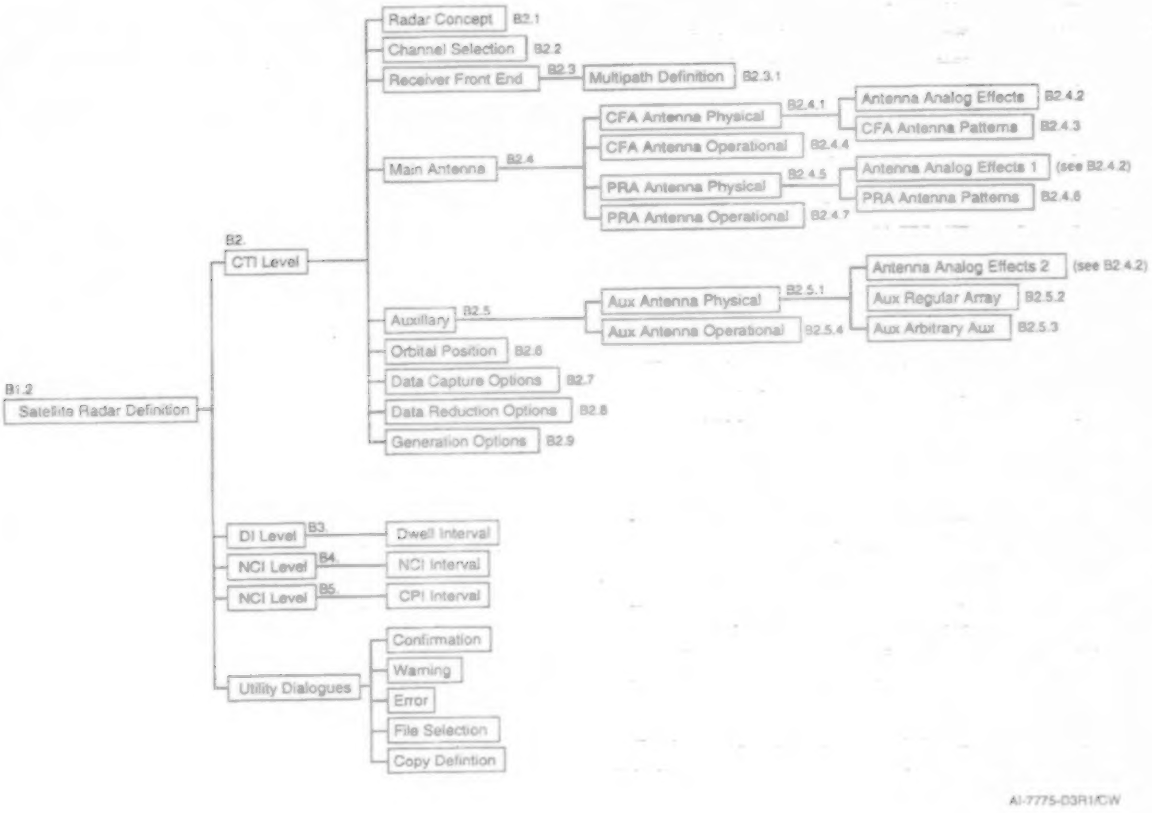
APPENDIX B

SATELLITE/RADAR HMI

B1. SATELLITE/RADAR DEFINITION HMI

B1.1 Dialogue Hierarchy Diagram

The Satellite/Radar definition, HMI, is used to define the characteristics of the SBR satellite and radar system, including the waveform to be simulated. The HMI is implemented using a hierarchy of dialogue boxes. Each dialogue box contains a related set of parameters, changeable at one interval level. Figure B-1 illustrates that hierarchy of dialogues.


B1.2
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B2.
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Radar Concept
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Channel Selection
B2.2
Receiver Front End
B2.3
Multipath Definition
B2.3.1
Main Antenna
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PRA Antenna Operational
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Auxiliary
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NCI Level
B5.
CPI Interval
Utility Dialogues
Confirmation
Warning
Error
File Selection
Copy Defintion
AI-7775-03R1/CW

Figure B-1 Satellite/Radar Definition Dialogue Hierarchy Diagram

B1.2 Top Level Dialogue

The top-level dialogue, titled Satellite/Radar Definition, is the initial dialogue presented when this HMI is activated, and the one from which all other lower level ones are accessed. This dialogue can be invoked by the command *satdef* at the Unix prompt.

The top-level dialogue is designed as a "visualization" window to provide an overview of the satellite and radar definition and to provide access to the lower-level dialogues which contain simulation parameters.

The top-level dialogue has the following areas:

- Pull-down menu bar items: File, Create, Delete, Validation;
- Text field display of current satellite/radar definition filename;
- CTI (or run) level definition area;
- Dwell level definition area;
- NCI definition area;
- CPI definition area;
- Validation message area.

Each area is designed as a paned window. The size of each pane can be adjusted by dragging the sash up or down. The sash is the small box at the bottom right side of each area. For example, the Validation Message Area can be enlarged without increasing the overall size of the window by dragging the CPI, NCI and DI sashes upward. The overall window size may also be manipulated by dragging the corners of the window.

Functional Associations

The Satellite/Radar Definition window gives the user an overview of both the "functional" and "temporal" associations of the simulation. The functional associations of parameters are shown by the grouping of parameters into the lower-level dialogues, which are represented by the titled "icons". Clicking once on any of these boxes opens the corresponding dialogue for display or editing of parameters. Only one lower-level box may be opened at once. If the top-level window appears unresponsive, check that any lower-level dialogues are open and first close them.

Temporal

The temporal associations are shown by the grouping of the dialogue icons into the four levels:

a. Contiguous Time Interval (CTI) or Run level: only one instance of these parameters exist;

b. Dwell level: a set of parameters are stored for each dwell in the run;

c. NCI level: a set of parameters are stored for each NCI in the current dwell;

d. CPI level: a set of parameters are stored for each CPI within the current NCI.

The current dwell, NCI and CPI are indicated in each level, and can be selected by the radio buttons and slider bars on each level. The radio buttons (diamond-shaped) permit only one interval to be selected at a time.

The temporal hierarchy in the SPD is fully general, that is, each dwell may contain a different number of NCIs, and each NCI may contain a different number of CPIs. These are individually limited as follows:

- Maximum number of dwells = 64 (per run or CTI)
- Maximum number of NCI per dwell = 12
- Maximum number of CPI per NCI = 64

Memory limitations in the DSP additionally limit simulated waveforms to a maximum of 240 NCI/run, and 3840 CPI/run. These limits are checked in the Satellite/Radar validation function.

Satellite/Radar HMI Operation

The satellite/radar HMI operation is summarized in the following:

- One sub-interval can be selected as current at each level

- One parameter dialogue is permitted to be open at a time

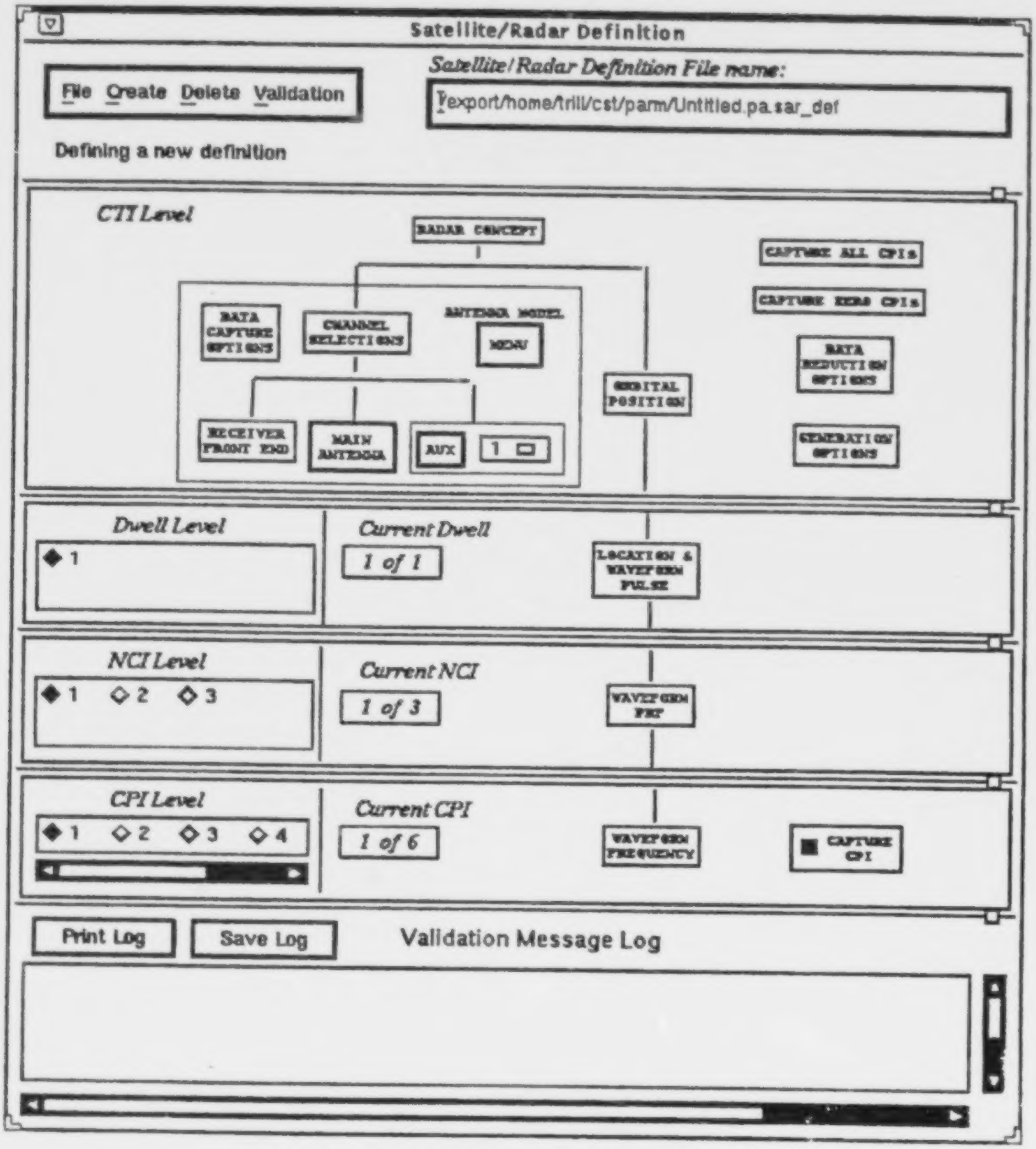
- Where a dialogue box has lower-level dialogues opened, this dialogue box cannot be exited until all lower dialogues are first exited.

Menu Bar Functions

The satellite/radar HMI provides four menu bar functions related to interval creation and file functions. These are described below in terms of the pull-down choices provided.

File ->

New	Initialize a new in-memory definition with default values. Prompt for either a CFA or RRA concept.
Open	Open an existing satellite/radar definition file.
Save	Save the in-memory definition to the current filename indicated
Save As	Save the in-memory definition to a new file specified in a file selection dialogue.


Satellite/Radar Definition
File
Create
Delete
Validation
CTI Level
RADAR CONCEPT
CAPTURE ALL CPIs
CAPTURE ZERO CPIs
DATA CAPTURE OPTIONS
CHANNEL SELECTIONS
ANTENNA MODEL
ORBITAL POSITION
DATA REDUCTION OPTIONS
RECEIVER FRONT END
MAIN ANTENNA
AUX
1
GENERATION OPTIONS
Dwell Level
◆ 1
LOCATION & WAVEFORM PULSE
NCI Level
◆ 1 ◇ 2 ◇ 3
WAVEFORM PRF
CPI Level
◆ 1 ◇ 2 ◇ 3 ◇ 4
WAVEFORM FREQUENCY
■ CAPTURE CPI
Print Log
Save Log
Validation Message Log

Satellite/Radar Definition File name: /export/home/trill/cst/parm/Untitled.pa.sar_def

Defining a new definition

Current Dwell: 1 of 1

Current NCI: 1 of 3

Current CPI: 1 of 6

Figure B-2 Satellite/Radar Definition Top-Level Dialogue

Exit	Exit from the Satellite/Radar Definition HMI. If changes have been made in the in-memory structure, a prompt to save changes will be made. The HMI will then prompt "OK to exit?" to confirm the exit action.

Create->

New	Create a new dwell, NCI or CPI interval (see A1.4)
Copy	Copy an existing dwell, NCI or CPI interval (see A1.3)

Delete-> Interval->

Delete the current dwell, NCI or CPI indicated. A confirmation box will be displayed before the delete action is completed. A waveform must have at least one dwell, and one NCI/DI, and one CPI/NCI.

Validation -> Start

Validation performs consistency checking on interdependent parameters in the Satellite/Radar definition. This validation checks a number of conditions including parameters that do not make physical sense (e.g. pulse width longer than PRI), and conditions which are outside the SPD simulation envelope (e.g. waveform too complex to be processed by DSP). The validation is performed by the CVAL CSU and any warnings or errors are displayed in the Validation Message Log area. The message log area is cleared each time validation is run.

Setting up a Definition

At the beginning of a new Satellite/Radar definition, the user should first select the radar concept: either a CFA or RRA SBR. The system will provide default values to all parameters which depend on the concept type. Changing from one concept to the other will reset all these dependent values to defaults. After selecting the concept, open each of the remaining dialogues in the CTI Level and edit the related parameters. Nominal default values are provided for all parameters, and only those requiring non-default values need to be edited after defining the SBR concept. The order of edits is not important.

The Antenna Model menu allows reuse of previously defined dialogues which are enclosed by the line rectangle, which includes:

- Channel Selections;
- Receiver Front End;
- Main and Auxiliary Antennas;
- Data Capture Options.

The antenna model "Menu" box provides a pull-down selection of actions to save and load previously saved definitions:

- "New" will initialize the antenna model parameters with defaults for selected SBR concept

- "Open" will open a previously defined antenna model
- "Save" saves the current definition into a previously opened or defined file
- "Save As" saves the antenna definition into a new file (prompts for the directory and filename)
- "Data Capture Options" allows selection of intermediate results capture in signal generation, and "Data Reduction Options" controls the decimation of these data.

The default parameters for CFA and RRA are based on the baseline definitions. Both cases default to two dwells, 3 NCIs, and a number of CPIs which depends on the SBR Concept (RRA:4, CFA:6). After selecting parameters at the CTI level, choose a dwell to edit, or delete or add dwells to get the desired scenario. After selecting the dwell, the dwell location and waveform pulse parameters may be edited in the Location & Waveform Pulse dialogue at the DI level.

After defining the desired dwells, the NCIs and CPIs within a dwell may be edited. At the NCI level, the dialogue box "Waveform PRF" allows definition of the PRF (by selecting an integer number of samples per PRI), and the number of coherent pulses per burst. These parameters are fixed for the CPIs in that NCI. Lastly, at the CPI level, the transmit radar frequency may be edited for each dwell. A default sequence of frequencies are set according to the SBR concept. Intervals in the waveform and dialogues may be edited in any order.

Once all the Satellite/Radar parameters are set to desired values, run a validation check (Validation->Start) and review any warnings reported. Edit and revalidate as required to get a satisfactory definition. Note that some conditions such as range eclipsing are reported as warning but are acceptable if a range eclipsing waveform is desired. Save the definition to a named file and exit the HMI.

Miscellaneous Notes:

The following are a few tips and reminders on use:

a. Under "Main Antenna - Physical", there are separate Phase Centre Analog Effects defined for each phase centre and each group. Be sure to edit the parameters for all groups and phase centres, if non-default values are desired.

b. Similarly, for auxiliaries, there are physical and operational definitions which are distinct for each auxiliary. Use the numeric selection bar to choose each auxiliary and edit its corresponding definition.

c. Validation may be used any time to do a consistency check on the definition currently in memory. It only reports inconsistencies or errors, but does not alter the parameters saved in memory.

B2. CONTIGUOUS TIME INTERVAL LEVEL

The following dialogues appear in the Satellite/Radar definition at the CTI level. In each dialogue, the parameters apply to entire duration on the run.

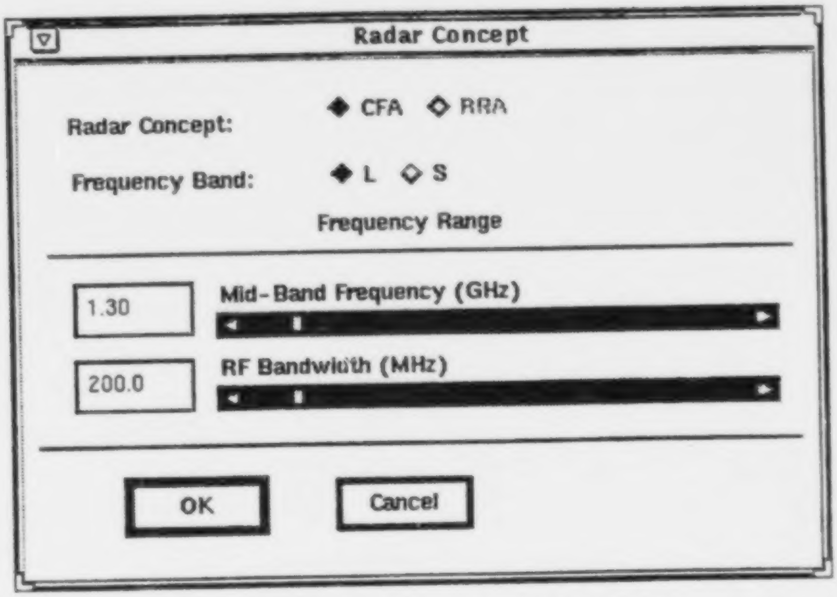
- Radar Concept
- Channel Selections
- Receiver Front End
- Main Antenna
- Auxiliary (one dialogue for each auxiliary)
- Orbital Position
- RSS Data Capture Options
- Data Reduction Options
- Generation Options

These dialogues and their subdialogues are described in the following subsection.

B2.1 Radar Concept

This dialogue box contains parameters associated with the "Radar Concept" definition. "Radar Concept" and "Frequency Band" each provide two choices which are used to initialize a number of other defaults in the Satellite/Radar dialogues. In this dialogue box, the Radar Concept is a display-only parameter. In order to change the SBR *Concept*, "File" -> "New" must be selected from the menu bar. This selection will prompt whether to save the current definition, and then whether to reinitialize all defaults to the new SBR concept.

Frequency Band is used to select L-band (CFA default) or S-band (RRA default) and are used to initialize a number of other parameters such as the range and default Mid-band Frequency and RF Bandwidth. If the Frequency Band is changed, it is followed by a prompt of whether the mid-band frequency and bandwidth values should be reinitialized. If "Change to defaults" is selected in this prompt, these values will be reinitialized to new ranges and defaults for the new band. If "Do not change" is selected then the range and default values are not altered in which case the frequencies are not changed, but could be inconsistent with the new band selected.



Radar Concept: ◆ CFA ◇ RRA
Frequency Band: ◆ L ◇ S
Mid-Band Frequency (GHz): 1.30
RF Bandwidth (MHz): 200.0

Figure B-3 Radar Concept Dialogue

Mid-Band Frequency together with **RF Bandwidth** determine the passband of the radar front end and affect a number of receiver related models. Mid-band Frequency specifies the middle of the receiver passband in the range 1.0 to 1.0 GHz (L-band) or 2.0 to 4.0 (S-band), depending on the choice of frequency band. Defaults are: L-band: 1.3 GHz, S-band: 3.0 GHz.

RF Bandwidth specifies the receiver RF bandwidth in the range 0 to 2000 MHz. Defaults are: L-band: 200 MHz, S-band: 400 MHz. The RF bandwidth should be set to cover the total range of frequency agility. The transmit frequency of each burst is set at the CPI level. The RF bandwidth will also affect the amount of jammer power received according to the overlap of the jammer spectrum and receiver passband. The lowest frequency in the receiver passband, and consequently the longest wavelength, is also coupled to the grid spacing of the array. Also note that the noise power is *not* generally determined by the RF bandwidth, but instead is determined by the bandwidth set in the "Receiver Front End" dialogue (Section B1.5).

B2.2 Channel Selections

This dialogue is used to define the number of main and auxiliary channels of the SBR. It allows selection of the number of groups and number of phase centres per group in the CFA case, and in both concepts, allows definition of auxiliary channels and tap delays.

In the top portion of the dialogue, the SBR concept is shown in a display-only text field.

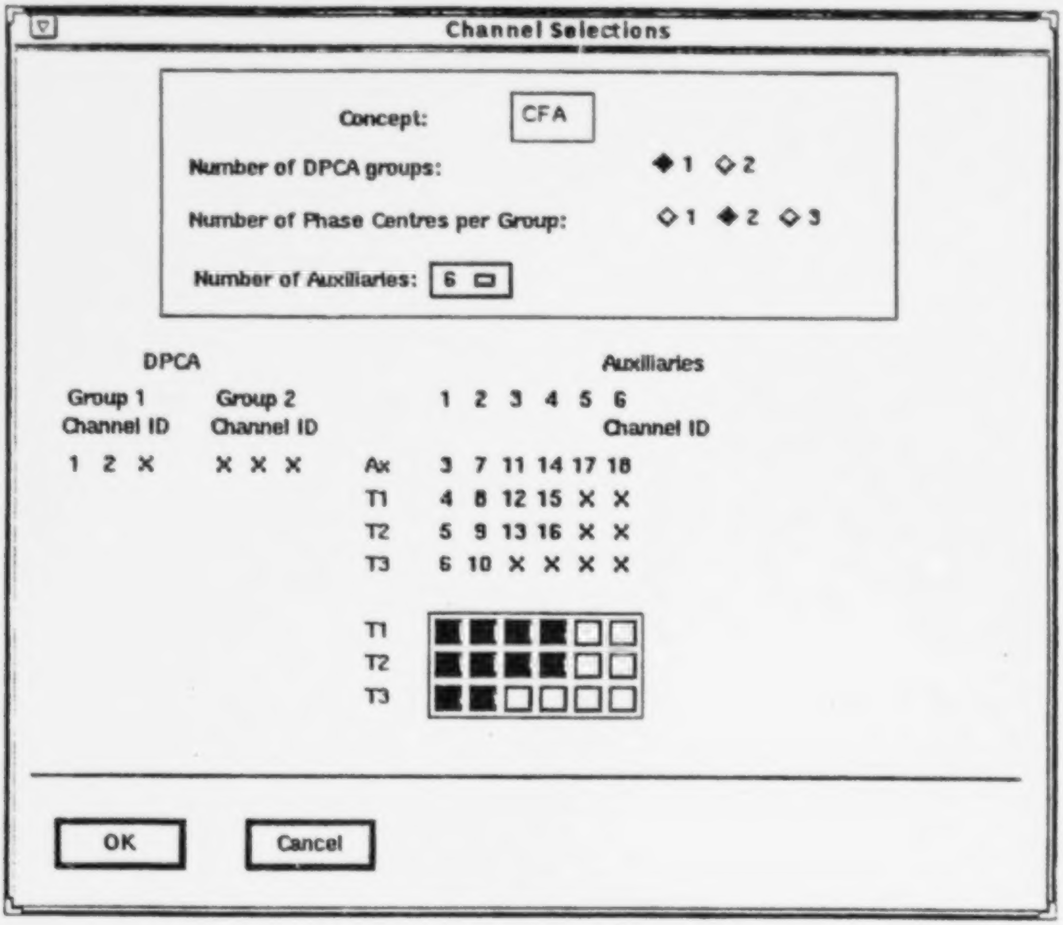
If the RRA concept is selected, the number of DPCA groups and the number of phase centres per group are preset to 1, and cannot be changed. The RRA concept only permits one main phase centre to be modelled for the reflector system. If CFA is selected, the **Number of DPCA Groups** may be selected as 1 or 2, and the **Number of Phase Centres per Group** may be 1, 2 or 3. The number of phase centres per group is the same for both groups.

"Number of Auxiliaries" is a pop-up selector bar which allows selection from 0 to a maximum of 16 auxiliary antennas for use in nulling or blanking. Changing the number of auxiliaries will update the tap delay selection field.

The lower portion of the dialogue consists of an index to the main and auxiliary channels with their numeric channel IDs. Channel IDs are assigned to the main phase centres, followed by auxiliaries starting from 1 for group 1 phase centre 1. For a two phase-centre group, "1" is the leading, "2" is trailing; for 3 PCs, "1" is leading, "2" is middle, and "3" is trailing. The Channel IDs are updated if any changes in the number of groups, phase centres, or auxiliaries.

Tap delays indicated by T1, T2 and T3 may be enabled individually for each auxiliary. A tap is selected by toggling a pushbutton in the pushbutton grid area. The button state indicates whether a tap is selected: "dark" or "filled" means the tap is enabled, while "light" or "not filled" indicates the tap is off. When each tap is selected, the auxiliary channel ID numbers are updated according to the rule of sequentially numbering each auxiliary and its taps in increasing order. Tap selection rules are:

- taps must be enabled in increasing delay order: i.e T1 must be on to select T2;
- each auxiliary may have a different number of delay taps;
- the total number of auxiliary and tap delays may not exceed 16;
- if the number of auxiliaries is reduced, the highest numbered auxiliaries are deleted;
- the number of auxiliaries can be increased, subject to the limit of 16 channels above.



Channel Selections

Concept: CFA

Number of DPCA groups: ◆ 1 ◇ 2

Number of Phase Centres per Group: ◇ 1 ◆ 2 ◇ 3

Number of Auxiliaries: 6

DPCA

Group 1 Channel ID	Group 2 Channel ID
1 2 X	X X X

Auxiliaries

	1	2	3	4	5	6 Channel ID
Ax	3	7	11	14	17	18
T1	4	8	12	15	X	X
T2	5	9	13	16	X	X
T3	6	10	X	X	X	X

T1	■	■	■	■	□	□
T2	■	■	■	■	□	□
T3	■	■	□	□	□	□

Figure B-4 Channel Selections Dialogue

B2.3 Receiver Front End

This dialogue is used to specify several receiver front-end characteristics, including some antenna, pulse, and quantizer properties.

Bandwidth in this dialogue controls the baseband signal bandwidth before digitization, and should be selected to match or exceed the bandwidth of the compressed pulse. This bandwidth is applied to the IF filter modelling and affects the noise power in the received signal. Limits are 0.1 to 6.0 MHz (default 1.0 MHz.). The pulse bandwidth is approximately 1/ (pulse width selected in each dwell).

Sampling Rate determines the complex sampling rate at the A/D converter, and may be selected from 0.1 to 9.0 Msamples/s (default 1.5 Msamples/s). The range cell size is determined from the sampling rate according to r = 1.5E8/Fs, so a 1-Msample/s rate yields a 150-metre range cell.

Main Beam Delay specifies a time-delay in the main phase centres, ranging from 0.0 to 300.0 ns (default zero). This may be used to delay the main beam to optimize the sampling time of the main beam relative to the tap delays. Ideally, to achieve maximum temporal diversity in nulling, the main beam delay should be set to the average delay of the auxiliaries and taps. For example, if one auxiliary is used with a 30 ns tap delay, the main channel delay should ideally be delayed half the tap delay, or 15 ns.

Polarization Selection allows a choice of H or V polarization for both transmit and receive (default: H). Only co-polarized reception is modelled. Cross-polarized SBR is not provided. The polarization influences the clutter reflectivity, which is based on empirical models. The interpretation of polarization also depends on the SBR concept. If CFA is selected, "H" is in the plane of the phased array antenna, and "V" is perpendicular to the array. If there is no antenna pitch or roll, then "V" will also be aligned with the vertical line to nadir.

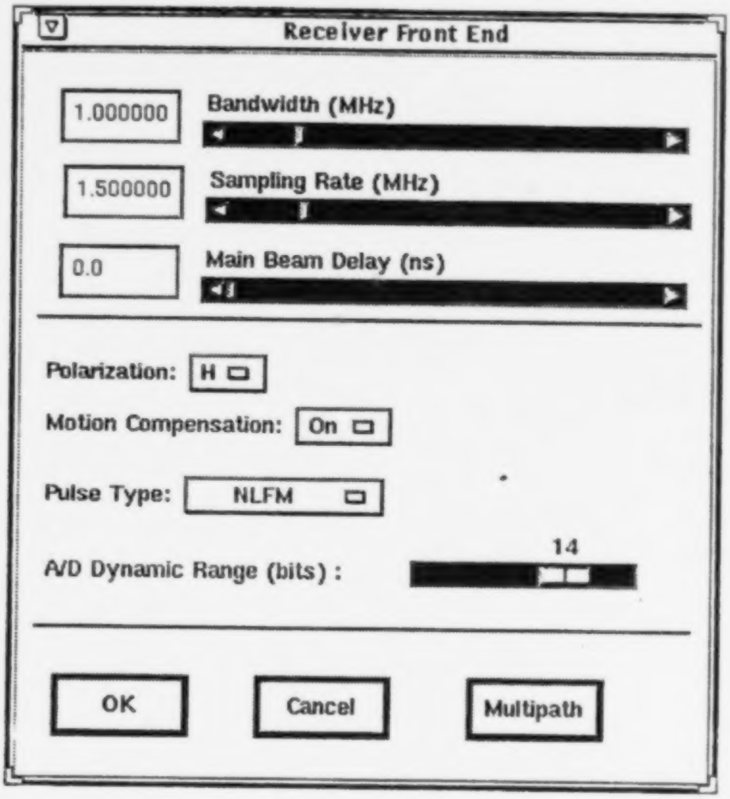
If the RRA concept is selected, the polarization is with respect to the rotating reflector beam axis. "H" means the electric vector is orthogonal to the beam axis and parallel to the plane of antenna rotation, and "V" is "H" rotated by 90-degrees around the beam axis.

Motion Compensation in this dialogue is used to select analogue receiver motion compensation to correct for SBR motion along-track. "On" (default) enables Doppler-corrected A/D sampling which employs different transmit and receive PRFs to correct for platform velocity. If analogue motion compensation is enabled, then digital Sampling Correction (SC) in the DSP need not be used. If analogue motion compensation is "Off", then SC should be enabled in the DSP to perform resampling for digital motion compensation.

Pulse Type selects the type of modulation used. Three pulse types are provided: Unmodulated, Linear Frequency Modulation (LFM), and Non-Linear Frequency Modulation (NLFM)(Default: NLFM).

A/D Dynamic Range selects the number of quantizer bits (range: 8 to 16 bits, default: 14).

Multipath opens a sub-dialogue box to allow specification of multipath scatterers on the SBR and is described in section B1.6.



Receiver Front End

Bandwidth (MHz): 1.000000

Sampling Rate (MHz): 1.500000

Main Beam Delay (ns): 0.0

Polarization: H

Motion Compensation: On

Pulse Type: NLFM

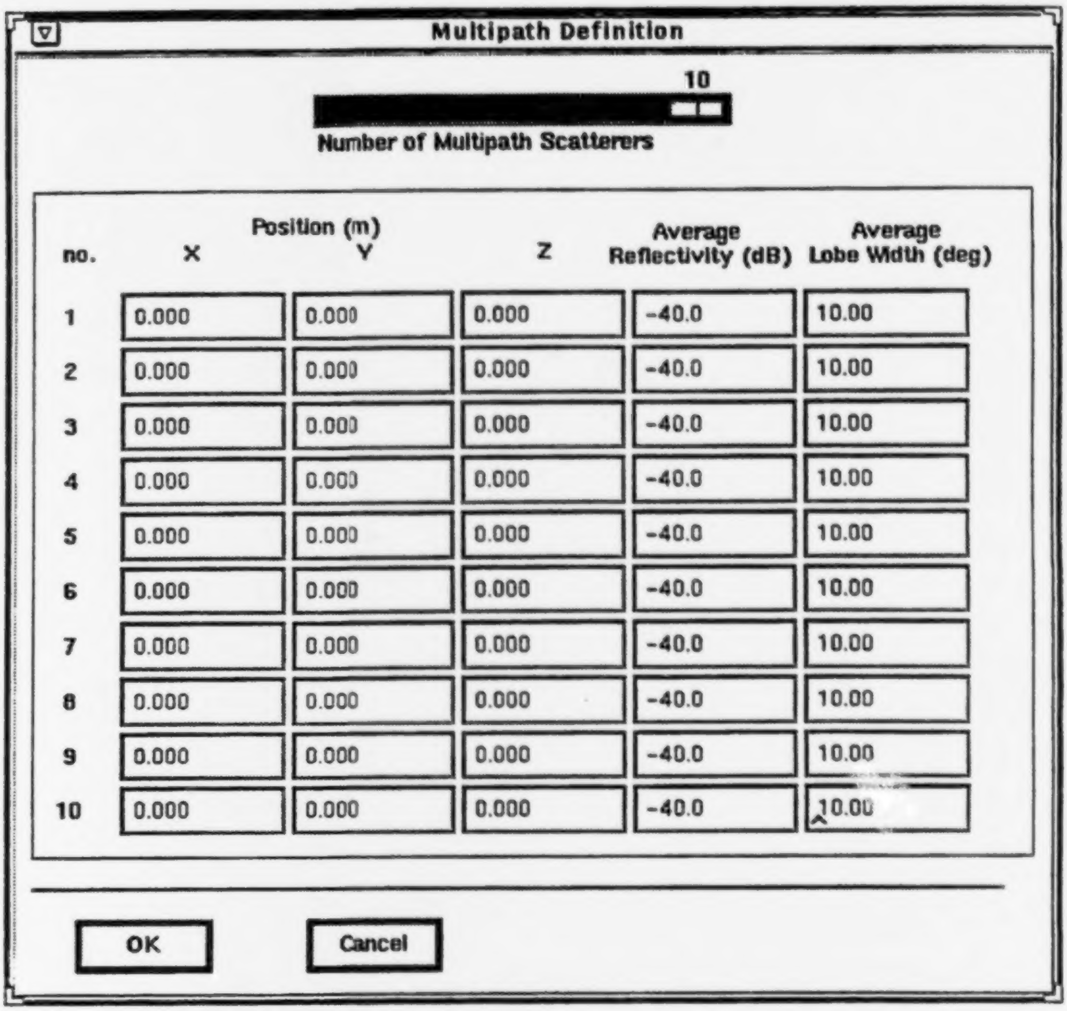
A/D Dynamic Range (bits) : 14

Figure B-5 Receiver Front End Dialogue

B2.3.1 Multipath Definition

This dialogue allows specification of up to 10 multipath scatterers in the near field of the SBR antenna. It is accessed from the Receiver Front End dialogue box. The number of desired multipath scatterers is set by dragging the slider bar from 0 (minimum) to 10 maximum. Each multipath scatterer is modelled as a discrete scatterer at a specified position (x,y,z) in antenna coordinates (x = along-track, y = right, z = down), with an average reflectivity (-80 to 0 dB, default: -40 dB), and average lobe width (0 - 90 degrees, default: 10 degrees). Multipath scatterers are fixed and do not rotate with the main reflector in RRA configurations. Each scatterer may be positioned anywhere within fixed limits of +/- 50-metres (default zero) w.r.t., the origin of the antenna. The multipath scatterer response is a randomly generated reflectivity pattern with the specified average reflectivity and lobe width. The average lobe width ensures that closely spaced paths have similar responses.

Note: In SPD Version 4.1, (November 1994), the multipath scatterer is not implemented.



Number of Multipath Scatterers: 10

no.	Position (m) X	Y	Z	Average Reflectivity (dB)	Average Lobe Width (deg)
1	0.000	0.000	0.000	-40.0	10.00
2	0.000	0.000	0.000	-40.0	10.00
3	0.000	0.000	0.000	-40.0	10.00
4	0.000	0.000	0.000	-40.0	10.00
5	0.000	0.000	0.000	-40.0	10.00
6	0.000	0.000	0.000	-40.0	10.00
7	0.000	0.000	0.000	-40.0	10.00
8	0.000	0.000	0.000	-40.0	10.00
9	0.000	0.000	0.000	-40.0	10.00
10	0.000	0.000	0.000	-40.0	10.00

Figure B-6 Multipath Definition Dialogue

B2.4 MAIN ANTENNA

The "Main Antenna" button in the top-level Satellite/Radar dialogue is used to access either CFA or RRA definitions, depending on the choice of SBR concept. For each concept, the main antenna dialogues are further organized into "Physical" characteristics related to the physical design of the antenna, and "Operational" characteristics which covers dynamic operational parameters (e.g., antenna attitude, RRA rotation, etc.). The following subsections describe all the dialogues and subdialogues related to the main antenna.

B2.4.1 CFA Antenna Physical

This dialogue is used to specify the physical characteristics of a corporate-fed phased array antenna system. The dialogue is accessed from "Main Antenna" at the CTI level when a CFA SBR is selected. The CFA physical characteristics are organized into four groups: Element definition, DPCA Groups, Aperture and Array Definition.

B2.4.1.1 Element Definition

Grid is used to select the type of element grid forming the main aperture corporate fed array. Two choices are provided: 1) Rectangular (default), and 2) Triangular. A triangular grid is effectively two overlaid rectangular grids with a displacement of 0.5 dX and 0.5 dY, where dX and dY are the grid spacing selected.

Note: In SPD Version 4.1 (November 1994), the triangular grid array is not implemented.

Grid Spacing (X, Y) specifies the spacing between elements in the main aperture, over a range of 0.0 to 0.3 m. The default value of 0.107 m corresponds to $\lambda/2$ for 2.8 GHz RF bandcentre, and should be increased if L-band (1.3 GHz) is selected. The grid spacing should be within the range 0.5 λ_{min} to λ_{max} to be validated, where λ_{min} in is the minimum transmit wavelength and λ_{max} is the maximum transmit wavelength.

Pattern is used to select the antenna element type and pattern. Four patterns are provided: Omni-directional, Bolt-Cassen, dipole, and horn types. If a horn is selected, the horn gain (0 to 20 dBi, default 10 dBi) may be entered.

Note: In SPD Version 4.1 (November 1994), the Bolt-Cassen, dipole and horn types are not implemented. Only the omnidirectional element is available.

B2.4.1.2 DPCA Groups

This set of parameters defines the DPCA groups for a CFA antenna. The number of groups and number of phase centres per group are display-only, and not changeable in this dialogue. They can only be changed in the "Channel Selections" dialogue. There is a maximum of two groups, with 3 phase centres per group. The number of phase centres per group is the same for two groups.

PRI Multiplier selects the phase centre separation in multiples of one PRI. One value is specified for all phase centres and groups. A floating-point value from 0.9 to 5.5 is allowed, but most simulations will use an integer separation 1, 2 or 3. Default is 3.0. A fractional separation may be used to experiment with systems where the phase centre locations are constrained in some way. The DPCA algorithms round this multiplier to the nearest integer for canceller delay. Within one group, the separation between two adjacent phase centres in along-track ("X" direction) is $2*PRI*PRI\_multiplier*V_s$, where V_s is satellite velocity.

Displacement from Aperture Centre specifies the centre (or centroid) of each group of phase centres in antenna (X,Y) coordinates, in the antenna plane (z = 0). If 3 phase centres per group is specified, this corresponds to the position of the middle phase centre. If two phase centres are used, then the centroid will be halfway between the two phase centres. The displacement range is fixed to -50 to 50 metres (default is zero), however, the displacement should be such that all phase centres lie within the physical aperture (array size).

Phase Centre Analog Effects opens a sub-dialogue box to specify characteristics of a phase centre receiver path. Each PC has its own definition, so one should ensure that all are edited to the desired values. This dialogue is described in section A2.8 following.

B2.4.1.3 Aperture

Along Motion specifies the size of the CFA aperture in the along-track satellite velocity vector, or "X" direction. A fixed range of 0 to 100 metres is provided (default 22.0 m).

Across Motion specifies the size of the aperture in the across motion (or "cross-track" or "Y") direction. A fixed range of 0 to 100 m is provided (default 6.0 m).

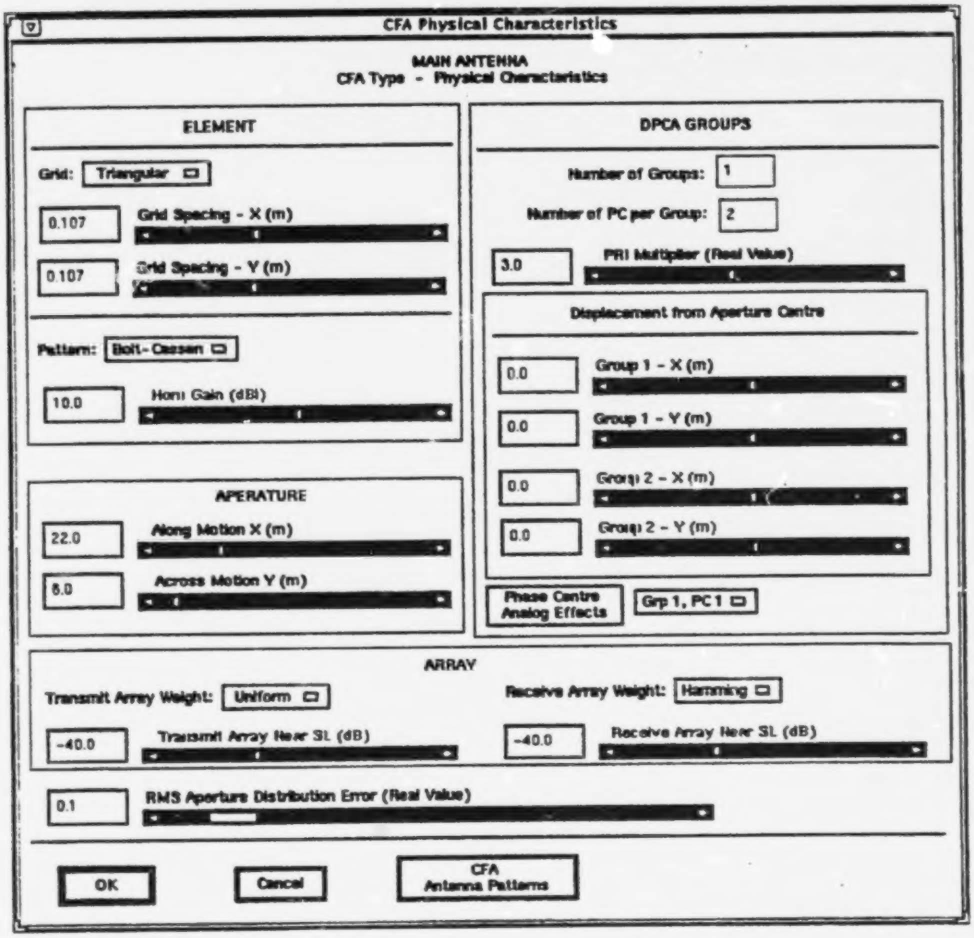
B2.4.1.4 Array Weighting

Transmit and receive array weighting is specified in terms of the near side lobe level in dB. Three types of weighting are provided: Uniform (default), Taylor, and Hamming (Defaults: Uniform Transmit, Hamming Receive). If Taylor is selected, a side lobe level of -20 to -50 dB (default -40.0 dB) may be specified. This defines the unperturbed side lobe levels.

B2.4.1.5 RMS Aperture Distribution Error

The RMS aperture distribution error controls a randomly generated disruption to the side lobes of the main beam and is specified as an RMS normalized value from 0.0 to 1.0 units. Aperture distribution error is modelled as a random variation in amplitude and phase across the 2D aperture. When the perturbed aperture is Fourier transformed to synthesize the antenna far-field pattern, it results in randomly varying sidelobes degrading the antenna response relative to a perfect aperture. The default value of 0.1 represents an RMS variation of 10%. Larger RMS distribution errors can be used to simulate more severe degradation in the SBR antenna.

CFA Antenna Patterns provides access to previously saved CFA antenna patterns. See section B2.4.3 for details.


CFA Physical Characteristics
MAIN ANTENNA
CFA Type - Physical Characteristics
ELEMENT
APERATURE
DPCA GROUPS
Displacement from Aperture Centre
ARRAY
Phase Centre Analog Effects
OK
Cancel
CFA Antenna Patterns

Grid: Triangular

Grid Spacing - X (m): 0.107

Grid Spacing - Y (m): 0.107

Pattern: Bolt-Cassen

Horn Gain (dBi): 10.0

Along Motion X (m): 22.0

Across Motion Y (m): 6.0

Number of Groups: 1

Number of PC per Group: 2

PRI Multiplier (Real Value): 3.0

Group 1 - X (m): 0.0

Group 1 - Y (m): 0.0

Group 2 - X (m): 0.0

Group 2 - Y (m): 0.0

Grp 1, PC 1

Transmit Array Weight: Uniform

Transmit Array Near SL (dB): -40.0

Receive Array Weight: Hamming

Receive Array Near SL (dB): -40.0

RMS Aperture Distribution Error (Real Value): 0.1

Figure B-7 CFA Physical Characteristics Dialogue

B2.4.2 Analogue Effects

This dialogue is used to define analogue effects of each main phase centre or auxiliary antenna channel modelled in signal generation. It includes receiver thermal noise, front-end non-linearity, IF filter/equalizer characteristic. This dialogue is accessed from the CFA or RRA Physical Characteristics dialogue (Phase Centre Analog Effects button), and also from the Auxiliary Antenna Physical Characteristics (Auxiliary Analog Effects button). The model parameters are common to these antenna channels and are described below. In the CFA case, note that a unique definition exists for each phase centre in each group, and all should be edited if non-default values are desired.

Receiver Noise Temperature specifies receiver noise in terms of equivalent noise temperature in degrees Kelvin. A fixed range of 0 - 10000 deg-K, and a default of 250 deg-K are provided. Receiver noise power is computed according to kTB, where k is Boltzmann's constant and B is the bandwidth set in the Receiver Front End dialogue. Total noise power in the RSS models accounts for receiver noise and external noise (from Earth and galactic sources).

Non-Linear Character specifies the type of front-end analogue model and is either "Ideal Linear" or "User-Entered" non-linear parameters. The default is Ideal Linear. If non-linear is selected, then four factors: *alpha_p* (α_p), *beta_p* (β_p), *alpha_q* (α_q), and *beta_q* (β_q), are applied. Valid range of each is 0 - 10, and defaults of $\alpha_p=1$, $\beta_p = 0$, $\alpha_q = 0$ and $\beta_q = 0$ are provided. These coefficients determine the shape of the AM/AM and AM/PM curves according to the model described in the Testbed Preliminary Design (R-13), Appendix J, section J9.

IF & Equalizer Character specifies the type of IF model to be used and is one of:

- Ideal Equalization (perfectly flat passband);
- User-Entered Mismatch (enter amplitude and phase mismatch, and number of ripples);
- Stored File (user-defined IF filter response saved in a file).

User-entered mismatch specifies a channel-to-channel amplitude and phase mismatch. Each IF response is modelled as an ideal flat response perturbed by a random error function, with the average amplitude and phase mismatch as specified. The number of ripples specifies the average number of maxima modelled in the random perturbation across the IF bandwidth.

A/D Character specifies the model used for the analogue-to-digital conversion of baseband received channels.

Three A/D converter models can be used:

- Ideal Linear;
- Provided Model;
- User-Entered Model.

An ideal linear response models a perfectly linear A/D converter across the full dynamic range (number of bits) specified. "Provided Model" uses a predefined file containing the A/D converter response. "User-Entered" uses a polynomial model of the A/D response, and its first time derivative. The "Signal" parameter represents a linear gain (a_1) in the range 0 to 20, and defaults to unity, while "Squared", "Cubed", etc. represents higher order terms (a_2, a_3, a_4, a_5) in the transfer function in the range -1 to 1 (default zero). The second row of parameters specifies the coefficients of the first time derivative (dv/dt) of the A/D response: "Derivative" is the coefficient of the first power of the derivative (b_1), "Squared" is the coefficient of the derivative squared (b_2), etc. Range of "b" values is -1 to 1 with a default of zero. The A/D model is described further Appendix J9 of the Testbed Preliminary Design, Document R-13.

I/Q Imbalance and DC Offsets specify analogue baseband errors in the A/D conversion process.

I/Q imbalance is modelled by an amplitude imbalance (ε) and a phase imbalance (ϕ), range -90 to 90 degrees, default zero. DC offsets in I and Q are specified as floating-point values in A/D converter units, that are applied after the I/Q imbalance (Range: -5.0 to 5.0, default 0.0). Figure B-8 illustrates the I/Q imbalance and DC offsets model.

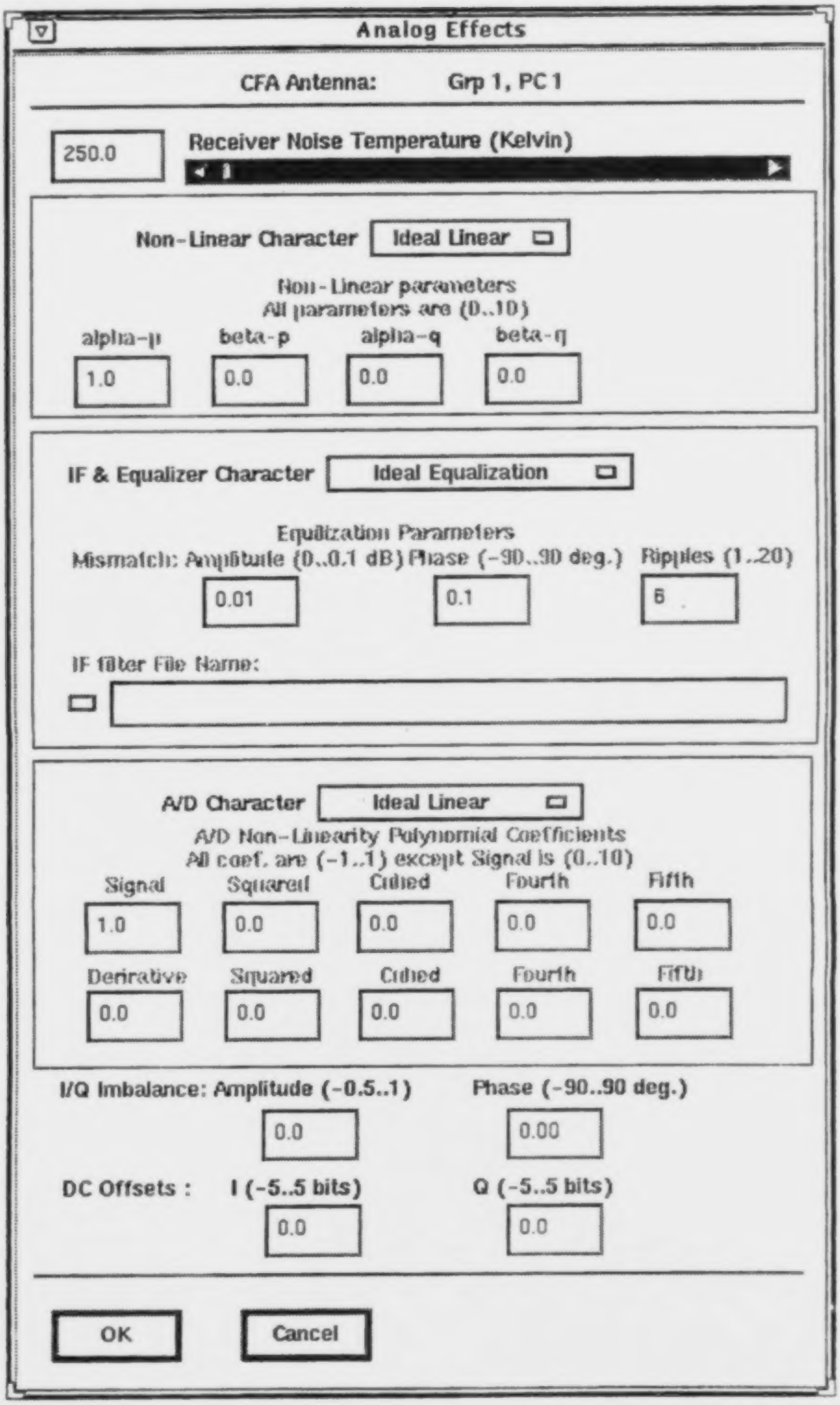
Note Concerning A/D Scale Factor

In the signal generation model used in the SPD, the A/D scale factor is automatically computed such that the noise voltage averages one bit in the quantized signal. More precisely, the A/D quantization is set equal to the RMS noise voltage referred to the receiver input, which is computed as the square root of the total noise power (sum of receiver noise, external and galactic noise). If the receiver noise temperature is changed, the apparent noise power in digital units will not change as a result of this scaling, however, the signal-to-noise ratio of targets and clutter will be altered. To prevent abnormally small quantization units if low noise or zero temperatures are selected (e.g., if all noise sources turned off), a minimum of 273-degrees Kelvin total noise temperature is used to define the quantum.

B2.4.3 CFA Antenna Patterns

This dialogue is used to specify the CFA antenna patterns used in signal generation. It is accessed from the CFA Antenna - Physical dialogue by selecting "CFA Antenna Patterns". Two types are provided: RSS-Generated and User-Generated. The default value "RSS Generated" causes signal generation to compute a pattern based on the aperture configuration, wavelength and weighting specified. If RSS Generated is selected, the remaining input area is not applicable and is "ghosted" for display.

If User-Generated is selected, then the user must enter a valid filename (standard Unix pathnames are used: */directory/filename*). Clicking the small button to the left of the field will activate a File Selection dialogue. The antenna pattern file uses the "U/V matrix" format which specifies the complex response in u,v coordinates, the direction cosines with respect to boresight. The format is compatible with "Phasar-C" output.



CFA Antenna: Grp 1, PC 1

Receiver Noise Temperature (Kelvin): 250.0

Non-Linear Character: Ideal Linear

Non-Linear parameters
All parameters are (0..10)

alpha-p	beta-p	alpha-q	beta-q
1.0	0.0	0.0	0.0

IF & Equalizer Character: Ideal Equalization

Equalization Parameters

Mismatch: Amplitude (0..0.1 dB)	Phase (-90..90 deg.)	Ripples (1..20)
0.01	0.1	5

IF filter File Name:

A/D Character: Ideal Linear

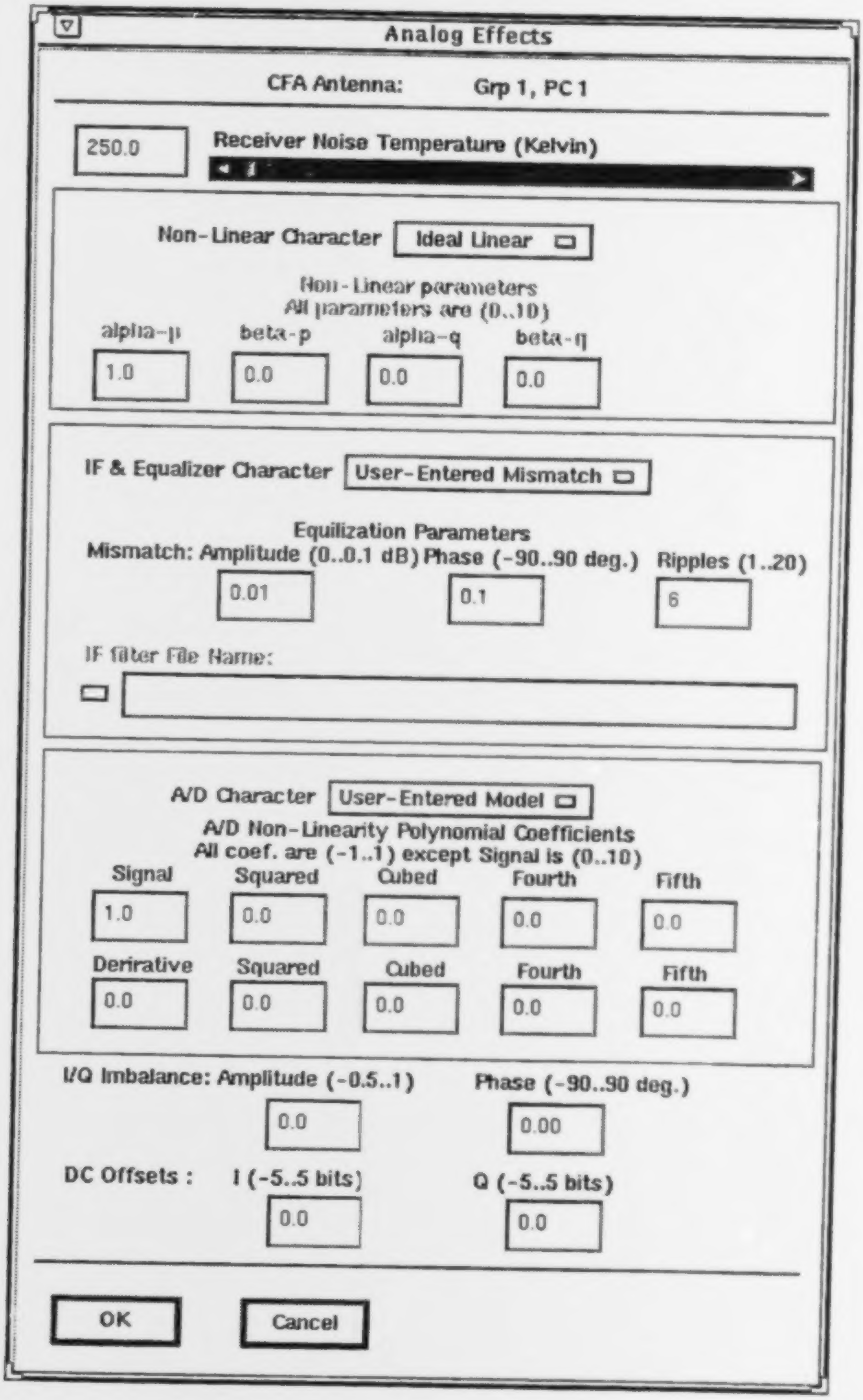
A/D Non-Linearity Polynomial Coefficients
All coef. are (-1..1) except Signal is (0..10)

Signal	Squared	Cubed	Fourth	Fifth
1.0	0.0	0.0	0.0	0.0
Derivative	**Squared**	**Cubed**	**Fourth**	**Fifth**
0.0	0.0	0.0	0.0	0.0

I/Q Imbalance: Amplitude (-0.5..1): 0.0
Phase (-90..90 deg.): 0.00

DC Offsets : I (-5..5 bits): 0.0
Q (-5..5 bits): 0.0

Figure B-8 Analog Effects Dialogue (Ideal Models)



CFA Antenna: Grp 1, PC 1

Receiver Noise Temperature (Kelvin): 250.0

Non-Linear Character: Ideal Linear

Non-Linear parameters
All parameters are (0..10)

alpha-p	beta-p	alpha-q	beta-q
1.0	0.0	0.0	0.0

IF & Equalizer Character: User-Entered Mismatch

Equilization Parameters

Mismatch: Amplitude (0..0.1 dB)	Phase (-90..90 deg.)	Ripples (1..20)
0.01	0.1	6

IF filter File Name:

A/D Character: User-Entered Model

A/D Non-Linearity Polynomial Coefficients
All coef. are (-1..1) except Signal is (0..10)

Signal	Squared	Cubed	Fourth	Fifth
1.0	0.0	0.0	0.0	0.0
Derirative	**Squared**	**Cubed**	**Fourth**	**Fifth**
0.0	0.0	0.0	0.0	0.0

I/Q Imbalance: Amplitude (-0.5..1): 0.0
Phase (-90..90 deg.): 0.00

DC Offsets : I (-5..5 bits): 0.0
Q (-5..5 bits): 0.0

Figure B-9 Analog Effects Dialogue (User-Entered Mismatch A/D Model)

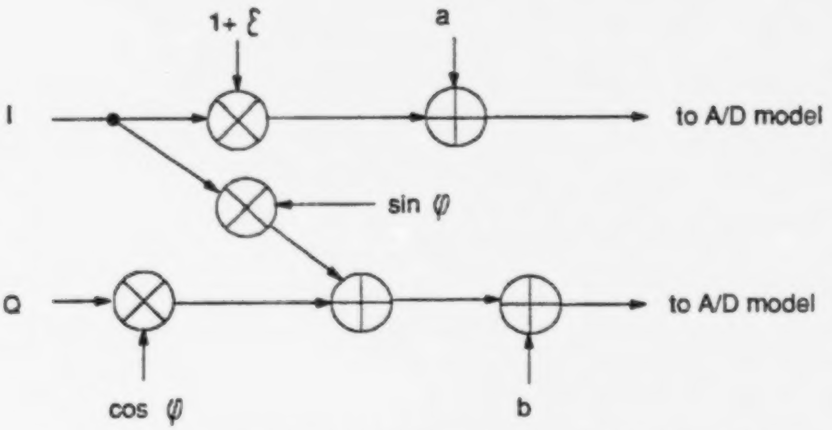


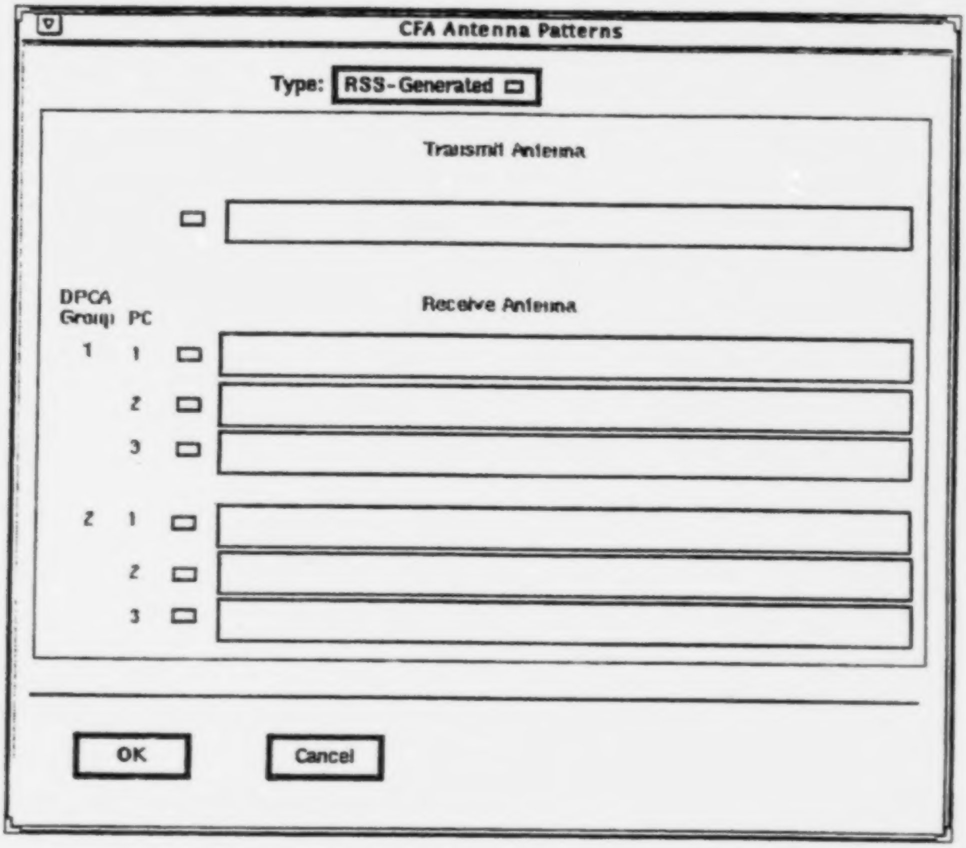
Figure B-10 I/Q Imbalance and DC Offset Model
(Reference: Figure J-36 of the Testbed Preliminary Design, Document R-13)

B2.4.4 CFA Operational Characteristics

This dialogue is used to specify operational characteristics of the CFA antenna, specifically consisting of the antenna attitude (roll, pitch, yaw). The angles have the following sense:

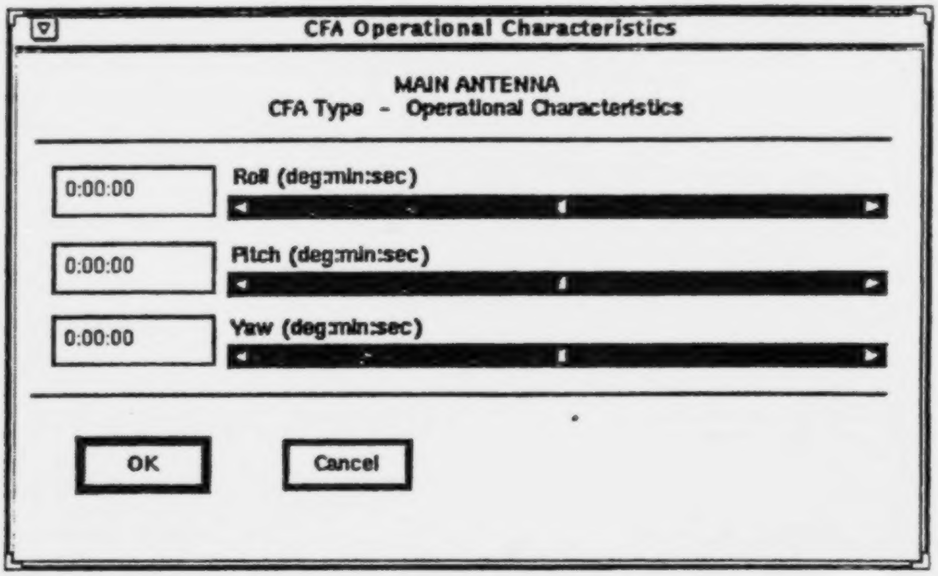
- Roll is about the "X" (forward) axis, with +ve roll right side down (zero is level);
- Pitch is about "Y" (across-track), with +ve pitch front upward (zero is level);
- Yaw is about "Z" (down): +ve yaw is rotation clockwise, viewed from above (zero is no yaw).

Fixed range of -90 to 90 degrees is provided for each (defaults zero - antenna parallel to earth surface and antenna "X" points to direction of satellite velocity vector).


CFA Antenna Patterns
Transmit Antenna
DPCA Group
PC
Receive Antenna
1
1
2
3
2
1
2
3
OK
Cancel

Type: RSS-Generated

Figure B-11 CFA Antenna Patterns Dialogue



CFA Operational Characteristics

MAIN ANTENNA
CFA Type - Operational Characteristics

Roll (deg:min:sec): 0:00:00

Pitch (deg:min:sec): 0:00:00

Yaw (deg:min:sec): 0:00:00

Figure B-12 CFA Operational Characteristics Dialogue

B2.4.5 RRA Antenna Physical

This dialogue is used to specify physical characteristics of the rotating reflector antenna in a RRA SBR concept. The antenna is a Cassegrain type modelled with a circular paraboloid main reflector and circular coaxial confocal paraboloid subreflector. Either a centre-fed or offset-fed design is modelled. The phased array feed allows some off-axis scanning of the beam.

Diameter specifies the diameter in metres of the main reflector (D) and subreflector (D_s). Default values of 25.0 m and 2.50 m are provided. The range of diameter is 0 - 100 m. To be valid, the following should be satisfied: $10\lambda_{min} \le D$ and $\lambda_{min} \le D_s \le D$, where λ_{min} is the minimum radar wavelength used in the waveform.

Focal Length specifies the focal length of the main reflector (f_m) and subreflector (f_s), in the range 0 to 100 m. The focal lengths should satisfy: $D/4 \le f_m \le D$ and $D_s/4 \le f_s \le$ smaller of (f, D_s). Defaults are: Main: 12.5 m, subreflector: 1.25 m.

Feed characteristics consist of:

Diameter is the feed diameter in the range 0 to 100 m (default 2.5 m). The feed diameter should be less than or equal to D_s, assuming a circular coaxial feed. Increasing the feed diameter will allow a greater range of off-axis scanning, but trades off increased blockage for a centre-fed design.

RMS Aperture Distribution Error is similar to the RMS distribution error for the CFA antenna, described in B2.4.1.5. The ideal unweighted or weighted aperture is perturbed by a random variation with this RMS error (normalized), which in turn gives rise to random side lobes above the unperturbed pattern. A range of 0.0 (none) to 1.0 (maximum error) is provided, with a default of 0.1 (10% aperture distribution error).

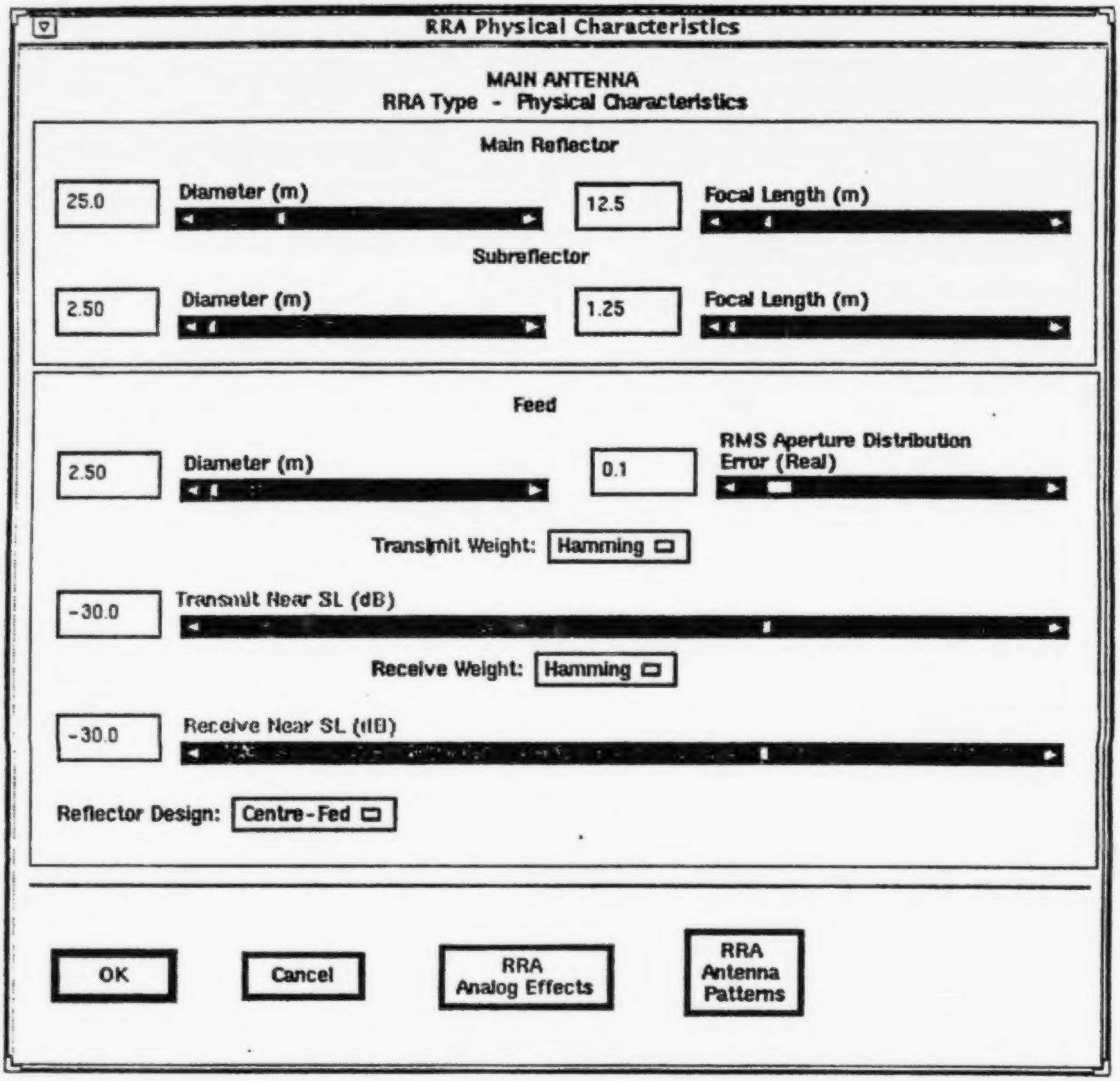
Note: In SPD Version 4.1 (November 1994), aperture distribution error is not implemented and the RMS error parameter does not affect the radar signal.

Transmit Weight and **Receive Weight** select a weighting for the aperture: Uniform, Taylor and Hamming (default) are provided, and the first sidelobe level is selectable in the range -50 to -20 dB for Taylor weighting (-30 dB default if Hamming enabled).

Reflector Design provides a choice of Centre-fed (default) or Offset-fed arrays. The offset-fed array avoids blockage of the main antenna, but is a more complicated design.

RRA Analog Effects provides access to a sub-dialogue box to define analog effects for the RRA receive channel. This dialogue is the same as that described above for the CFA case. Refer to section B2.4.2 for a complete description of parameters in Analog Effects, their range of values and defaults.

RRA Antenna Patterns provides a sub-dialogue box to specify the type of antenna pattern, and is described in the next section.



RRA Physical Characteristics

MAIN ANTENNA
RRA Type - Physical Characteristics

Main Reflector

Diameter (m): 25.0
Focal Length (m): 12.5

Subreflector

Diameter (m): 2.50
Focal Length (m): 1.25

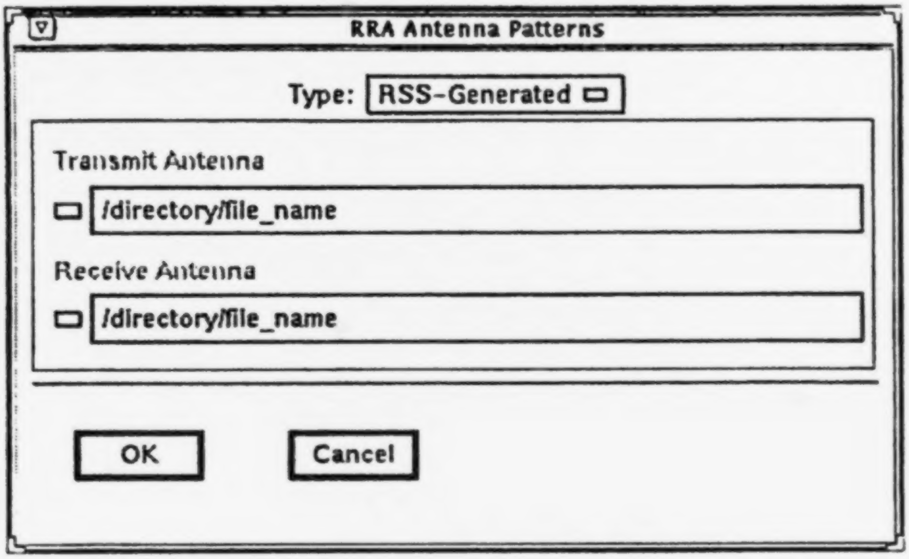
Feed

Diameter (m): 2.50
RMS Aperture Distribution Error (Real): 0.1
Transmit Weight: Hamming
Transmit Near SL (dB): -30.0
Receive Weight: Hamming
Receive Near SL (dB): -30.0
Reflector Design: Centre-Fed

Figure B-13 RRA Physical Characteristics Dialogue

B2.4.6 RRA Antenna Patterns

This dialogue box provides selection of the RRA antenna patterns and is accessed from the RRA Physical Characteristics dialogue by pressing "RRA Antenna Patterns". This dialogue is very similar to that for the CFA antenna, described above in section B2.4.3 but only one transmit and receive pattern may be specified. If "User-Generated" is selected then transmit and receive antenna fields become active and a valid filename must be given. Clicking the small button to the left of each field will activate a Select File pop-up dialogue. If "RSS-Generated" is selected, the file selection is dimmed and is not applicable. The antenna pattern file formats are the same as the U/V-matrix for the CFA case.


RRA Antenna Patterns

Type: RSS-Generated

Transmit Antenna: /directory/file_name

Receive Antenna: /directory/file_name

Figure B-14 RRA Antenna Patterns Dialogue

B2.4.7 RRA Antenna Operational Characteristics

This dialogue allows selection of a number of operational characteristics of the rotating reflector antenna. It is accessed from Main Antenna - Operational, when the RRA concept is selected.

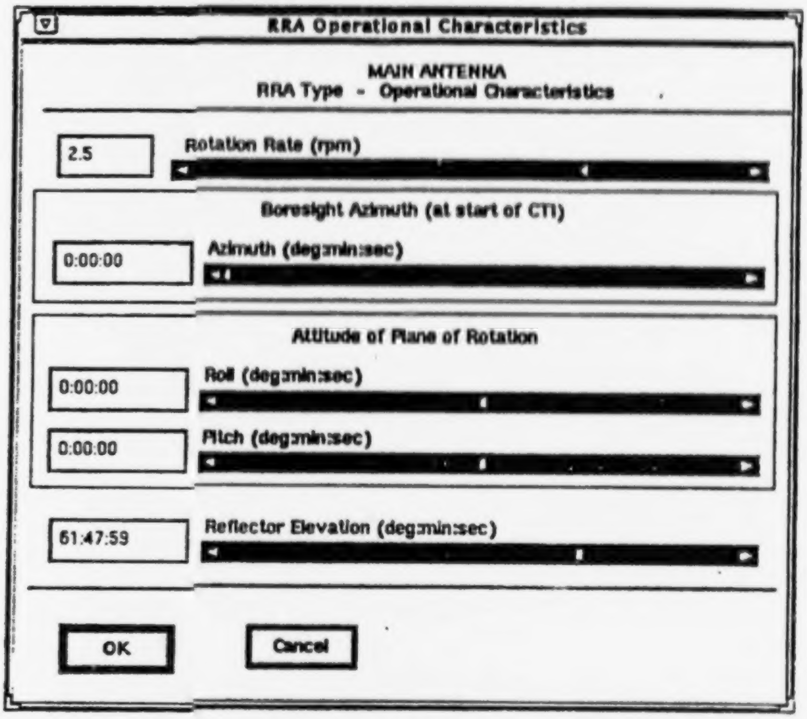
Rotation Rate specifies the rotation rate of the reflector in the range -6 to 6 Revolutions Per Minute (RPM) about the vertical downward (Z) axis. Default is 2.5 RPM. Positive rotation is clockwise looking down the Z axis (viewing the RRA SBR from above), and corresponds to a boresight azimuth angle increasing with time.

Boresight Azimuth specifies the initial rotation angle of the RRA reflector axis about the axis of rotation at the start of the CTI (leading edge of first burst transmitted). It is specified as an angle about Z, starting from 0 (pointing ahead in the direction of SBR travel along X) through 90-degrees (pointing right); 180 degrees (pointing behind); 270-degrees (left) to a maximum of 360 (ahead - same as zero). Default is zero (pointing ahead). Also see illustration of azimuth scan angle phi (ϕ) in Figure G-12.

Attitude of Plane of Rotation specifies a roll and pitch angle of the plane of rotation relative to level (axis of rotation aligned with nadir) and can be used to simulate satellite attitude errors. A range of +/- 90-degrees is allowed. Roll and pitch sign follow the same convention in the satellite coordinates: +ve roll is right down (axis of rotation shifted left from nadir), and +ve pitch is forward up (axis of rotation shifted behind from nadir). Defaults are zero pitch and zero roll-level rotation plane.

Reflector Elevation specifies the elevation of the axis of the RRA measured from the axis of rotation. Valid range is from 0 (pointing directly down axis of rotation) to 90-degrees (pointing in the plane of rotation and perpendicular to rotation axis). This elevation angle is applied after any roll or pitch is modelled in the plane of rotation. Default is 61:48:00 (61.8°).

Beam pointing for each dwell is electronically scanned off this axis to the desired dwell location (specified in lat/long or boresight offset angles). The off-axis angle $(u^2+v^2)^{0.5}$ may not exceed the RRA scan limit, which depends on the RRA dimensions and feed diameter. If the error "Dwell # nn cannot be scanned" is generated during validation, the boresight azimuth and/or elevation need to be adjusted or the desired dwell locations moved, to satisfy the scan limits. To find the beam centre position in lat/long for a given RRA SBR configuration, for example, to place targets in positions that can be scanned, select zero offset angles in the Dwell Definition dialogue and use the Validation function to compute and display the centre of each dwell.



RRA Operational Characteristics

MAIN ANTENNA
RRA Type - Operational Characteristics

Rotation Rate (rpm): 2.5

Boresight Azimuth (at start of CTI)

Azimuth (deg:min:sec): 0:00:00

Attitude of Plane of Rotation

Roll (deg:min:sec): 0:00:00

Pitch (deg:min:sec): 0:00:00

Reflector Elevation (deg:min:sec): 61:47:59

Figure B-15 RRA Operational Characteristics Dialogue

B2.5 AUXILIARY ANTENNAS

The "Auxiliary" button in the top-level Satellite/Radar dialogue is used to access physical and operational characteristics of each auxiliary. These dialogues are described below.

B2.5.1 Auxiliary Antenna Physical Characteristics

This dialogue is used to specify physical characteristics of each auxiliary antenna for the SBR. It is applicable to auxiliaries in either the CFA or RRA concept. The dialogue is accessed from the "Aux" icon in the Satellite/Radar Definition CTI level. One definition exists for each auxiliary antenna, and is selected in the top-level dialogue by the selector bar adjacent to the "Aux" icon. The auxiliary antenna number is indicated in this dialogue in the upper left corner as **AUX ID**, counting from 1 to a maximum of 16,

Auxiliary Type selects the type of auxiliary antenna. Three auxiliary types are provided:

• Single Element	(valid for RRA or CFA)
• Regular Array	(valid for CFA only)
• Arbitrary Array	(valid for CFA)

If the RRA concept is selected, only Single Element Auxiliary can be selected, and the others are ghosted out.

Element Pattern selects the element pattern to be used. Four patterns are provided:

- Omni-directional (default)
- Bolt-Cassen
- Dipole
- Horn

Note: In SPD Version 4.1 (November 1994), Bolt-Cassen, dipole and horn element types are not implemented.

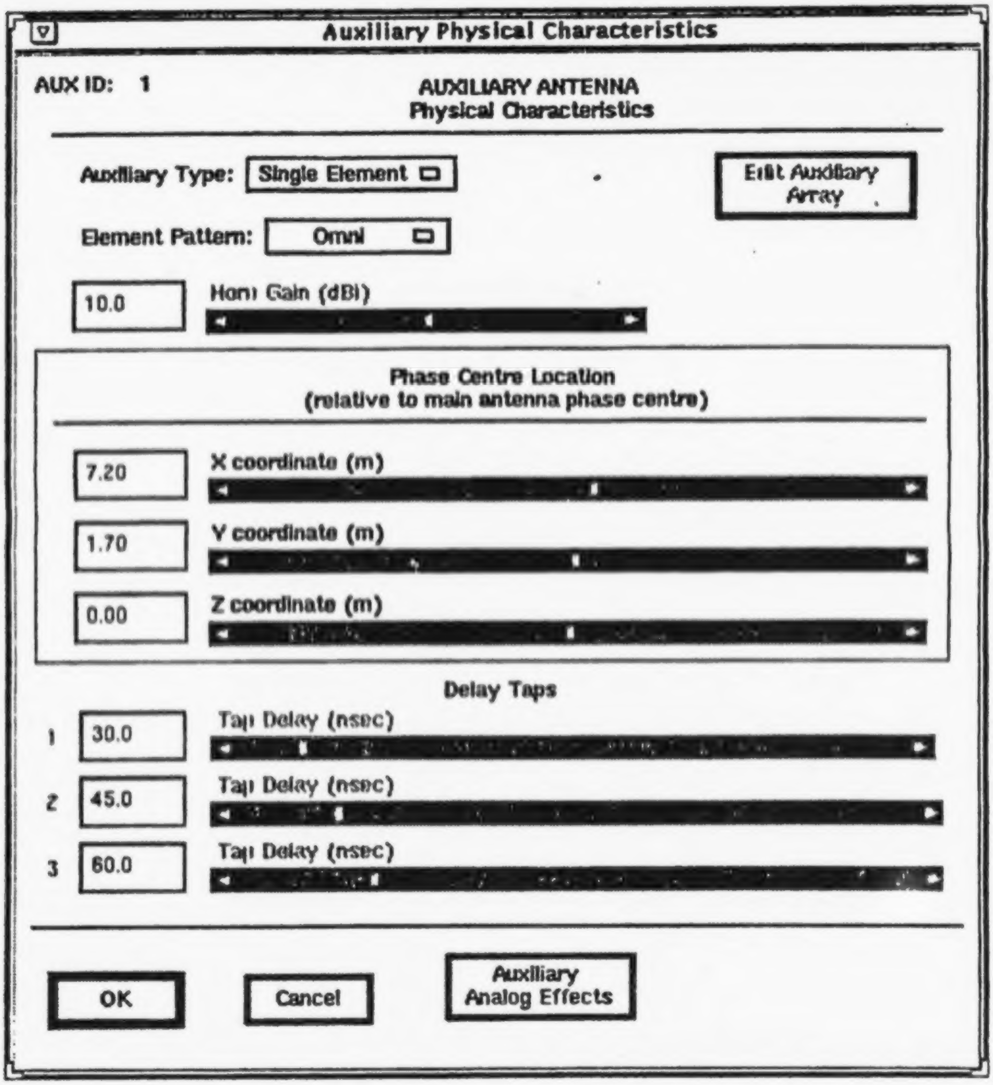
If a Horn type auxiliary is selected, the **Horn Gain** parameter is enabled, otherwise it is ghosted out and not applicable. The valid range of horn gain modelled is 0 to 20 dBi (default 10 dBi).

Edit Auxiliary Array provides access to a sub-dialogue to define a regular or arbitrary array auxiliary. This is only available if the Auxiliary Type is Regular Array or Arbitrary Array.

Phase Centre Location specifies the position of the auxiliary antenna phase centre in antenna coordinates (X: ahead, Y: right, Z: down). The X/Y/Z coordinate of the auxiliary is unrestricted in the range of -100 m to 100 m with respect to the antenna origin. Auxiliaries may lie outside or behind the main antenna for modelling purposes (even though some configurations would be physically unrealizable). Fixed default values are provided to give a semi-random distribution in X and Y (z = 0 for all default auxiliaries).

Delay Taps are used to specify the delay for each tap selected for that auxiliary. An unrestricted range of 0 - 300 ns is allowed. Only the taps selected in Channel Selections will be enabled. Default values are T1: 30 ns, T2: 45 ns, T3: 60 ns.

Auxiliary Analog Effects provides access to a lower-level dialogue to specify the analog receiver, IF and A/D effects modelled for that auxiliary. The parameters are the same as Analog Effects for the main phase centres. Refer to section B2.4.2 for details.



Auxiliary Physical Characteristics

AUX ID: 1

AUXILIARY ANTENNA
Physical Characteristics

Auxiliary Type: Single Element

Element Pattern: Omni

Horn Gain (dBi): 10.0

Phase Centre Location
(relative to main antenna phase centre)

X coordinate (m): 7.20

Y coordinate (m): 1.70

Z coordinate (m): 0.00

Delay Taps

1 Tap Delay (nsec): 30.0

2 Tap Delay (nsec): 45.0

3 Tap Delay (nsec): 60.0

Figure B-16 Auxiliary Physical Characteristics Dialogue

B2.5.2 Auxiliary Antenna Regular Array Definition

This dialogue is used to specify a regular array definition for one auxiliary antenna. It is accessed from the Auxiliary Physical Characteristics by selecting "Edit Auxiliary Array" with either Regular Array or Arbitrary Array selected. It is available for the CFA concept only. This dialogue allows selection of the auxiliary array tracking, aperture, element grid and weighting.

Array Tracking is used to enable tracking of the main beam by the auxiliary, and is normally enabled.

Tracking Array Offset is used to specify the azimuth and elevation offset of the tracking auxiliary. For a tracking array, offsets are relative to boresight, and the range of values is +/- 90 degrees. For a fixed auxiliary, the offsets are relative to array normal, and have the range of 0 to 90 degrees elevation, 0 to 360 degrees azimuth (defaults zero).

Aperture specifies the along track (X) and across-track (Y) dimensions of the auxiliary array. Range of values: 0 - 100 m each (defaults to zero - set to desired size).

Element Grid and Spacing specifies the form of array grid and its dimensions. The default element grid is the same as the main array, but can be changed independently to a different grid. The grid spacing specifies the separation of elements in the array in *dX* and *dY*, similar to the main grid. Default values are 0.5 λ_{min}. Valid range is 0.5 λ_{min} to λ_{min} where λ_{min} is the minimum wavelength computed from initial values of mid-band frequency and RF bandwidth set when the definition is created. (For L-band λ_{min} = 0.2143 m and for S-band λ_{min} = 0.0938 min, giving a default grid spacing of 0.1072 m and 0.0468 m respectively.

Array Weight and Near Sidelobe (SL) specifies the weighting to be applied to the auxiliary array. There are three choices of weighting: Uniform, Taylor, and Hamming. If Taylor is selected, the near side lobe level is selectable in the range -50 to -20 dB (default -30 dB).

B2.5.3 Auxiliary Antenna Arbitrary Array Definition

This dialogue is used to specify an arbitrary array definition for one auxiliary antenna. It is accessed from the Auxiliary Physical Characteristics by selecting "Edit Auxiliary Array" with Arbitrary Array selected. This dialogue is used to define an auxiliary consisting of an arbitrary number of elements (up to 16), summed with specified phase and amplitude weights. It can be used to design an auxiliary with a specific pattern, for example, one with a null at the main beam to reduce clutter in the auxiliary channel.

The arbitrary array may be modelled as fixed or tracking, with tracking the default. If tracking is selected, the phase shifts are entered assuming zero main beam scan angles (normal to the array). When the main beam is scanned off of normal, the arbitrary array is scanned by the same amount. This ensures that the position of the auxiliary beam remains at a constant offset relative to the main beam.

The number of elements in the array is selectable from 0 to 16, with 4 as the default. Changing the number of elements updates the list of element numbers. If the number of elements is increased, the user is prompted to either change all existing elements to their defaults, or to not change the existing ones.

The element location, phase shift and amplitude weight are listed for each auxiliary. The illustration in Figure B-17 shows the default values for a 16-element arbitrary auxiliary. The location of each element is specified in X,Y,Z relative to the phase centre of the auxiliary. Range of values are:

Position:	-100 m to 100 m
Phase:	-180 to 180 degrees
Amplitude:	Any real number ($0 < a < 1.0E+38$).

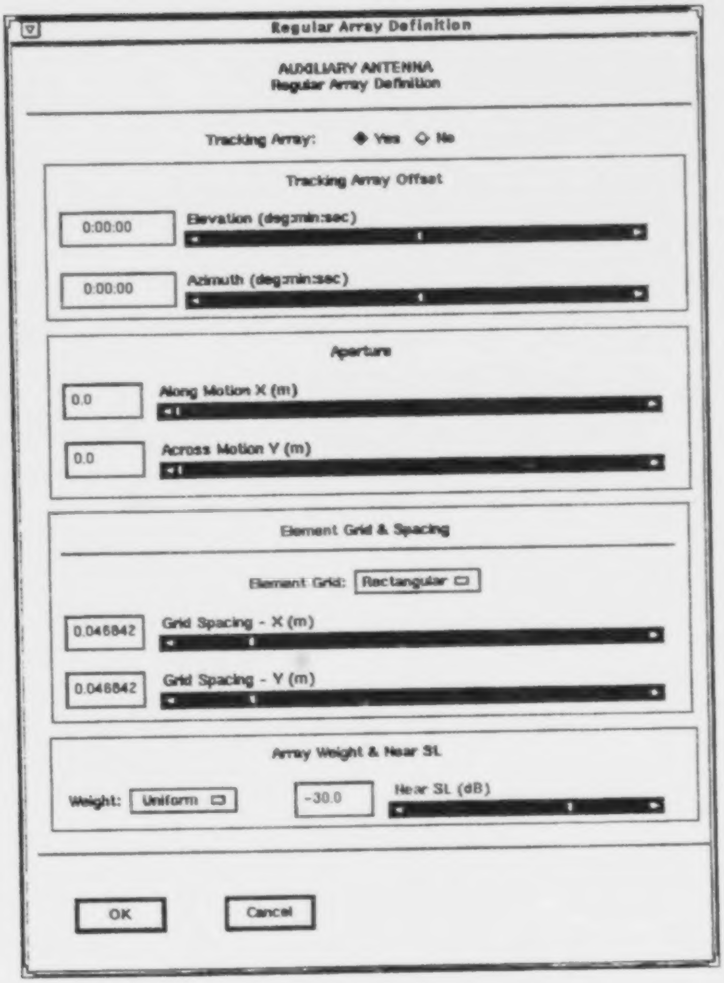
B2.5.4 Auxiliary Antenna Operational Characteristics

This dialogue box is used to specify the operational characteristics of each auxiliary antenna. It is accessed from the Satellite/Radar Definition CTI level through the "Aux" -> "Operational" selection. These parameters are defined individually for each auxiliary, the auxiliary is identified in the upper left corner, counting from 1 for the first auxiliary.

Site is used in the RRA concept to indicate whether the auxiliary rotates with the main reflector or is fixed to the spacecraft. If the RRA is selected, this parameter defaults to Rotating. If the CFA concept is used, only Fixed is available.

Attitude for Fixed Auxiliary is enabled when a Fixed auxiliary is selected. This is used to specify the attitude of a fixed auxiliary antenna relative to spacecraft level. Valid ranges of +/- 90 roll, pitch and yaw are provided, with defaults of zero.

Attitude for Rotating Auxiliary specifies the attitude of a rotating auxiliary antenna. Azimuth Offset (+/- 180 max.) is the azimuth offset angle of the auxiliary relative to the main reflector axis, measured about the axis of rotation. Elevation specifies the elevation angle of the auxiliary relative to the axis of rotation, where 0-degrees is along the axis (auxiliary would point to nadir if axis of rotation is vertical), and 90-degrees is perpendicular to the axis of rotation (auxiliary would be pointing in the plane of rotation). Default elevation of auxiliary is equal to that of main reflector axis.



Regular Array Definition

AUXILIARY ANTENNA
Regular Array Definition

Tracking Array: ◆ Yes ◇ No

Tracking Array Offset

Elevation (deg:min:sec): 0:00:00

Azimuth (deg:min:sec): 0:00:00

Aperture

Along Motion X (m): 0.0

Across Motion Y (m): 0.0

Element Grid & Spacing

Element Grid: Rectangular

Grid Spacing - X (m): 0.046842

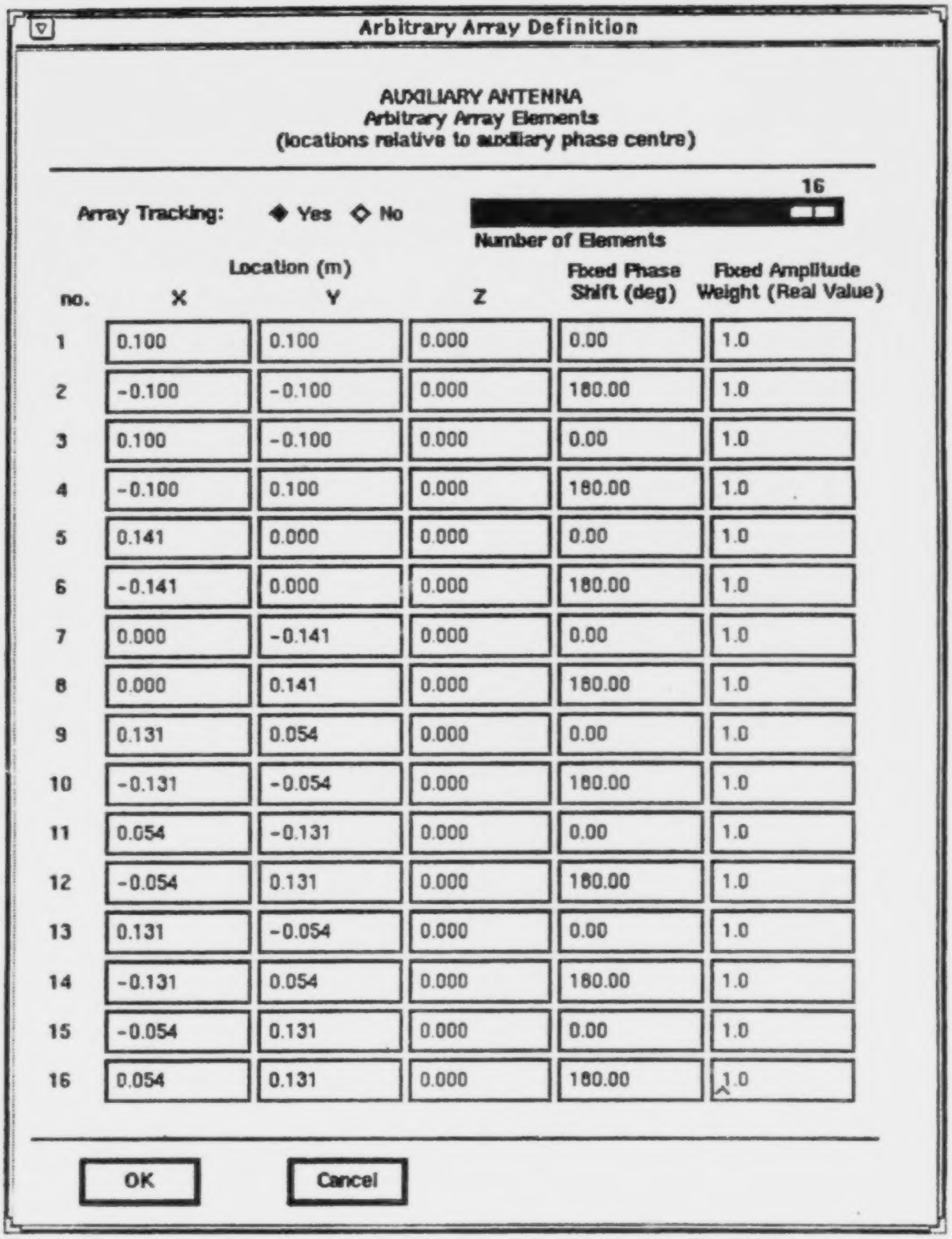
Grid Spacing - Y (m): 0.046842

Array Weight & Near SL

Weight: Uniform

Near SL (dB): -30.0

Figure B-17 Auxiliary Regular Array Definition Dialogue



AUXILIARY ANTENNA
Arbitrary Array Elements
(locations relative to auxiliary phase centre)

Array Tracking: ◆ Yes ◇ No

16
Number of Elements

	Location (m)			Fixed Phase Shift (deg)	Fixed Amplitude Weight (Real Value)
no.	X	Y	Z		
1	0.100	0.100	0.000	0.00	1.0
2	-0.100	-0.100	0.000	180.00	1.0
3	0.100	-0.100	0.000	0.00	1.0
4	-0.100	0.100	0.000	180.00	1.0
5	0.141	0.000	0.000	0.00	1.0
6	-0.141	0.000	0.000	180.00	1.0
7	0.000	-0.141	0.000	0.00	1.0
8	0.000	0.141	0.000	180.00	1.0
9	0.131	0.054	0.000	0.00	1.0
10	-0.131	-0.054	0.000	180.00	1.0
11	0.054	-0.131	0.000	0.00	1.0
12	-0.054	0.131	0.000	180.00	1.0
13	0.131	-0.054	0.000	0.00	1.0
14	-0.131	0.054	0.000	180.00	1.0
15	-0.054	0.131	0.000	0.00	1.0
16	0.054	0.131	0.000	180.00	1.0

Figure B-18 Auxiliary Arbitrary Array Definition Dialogue

B2.6 Orbital Position

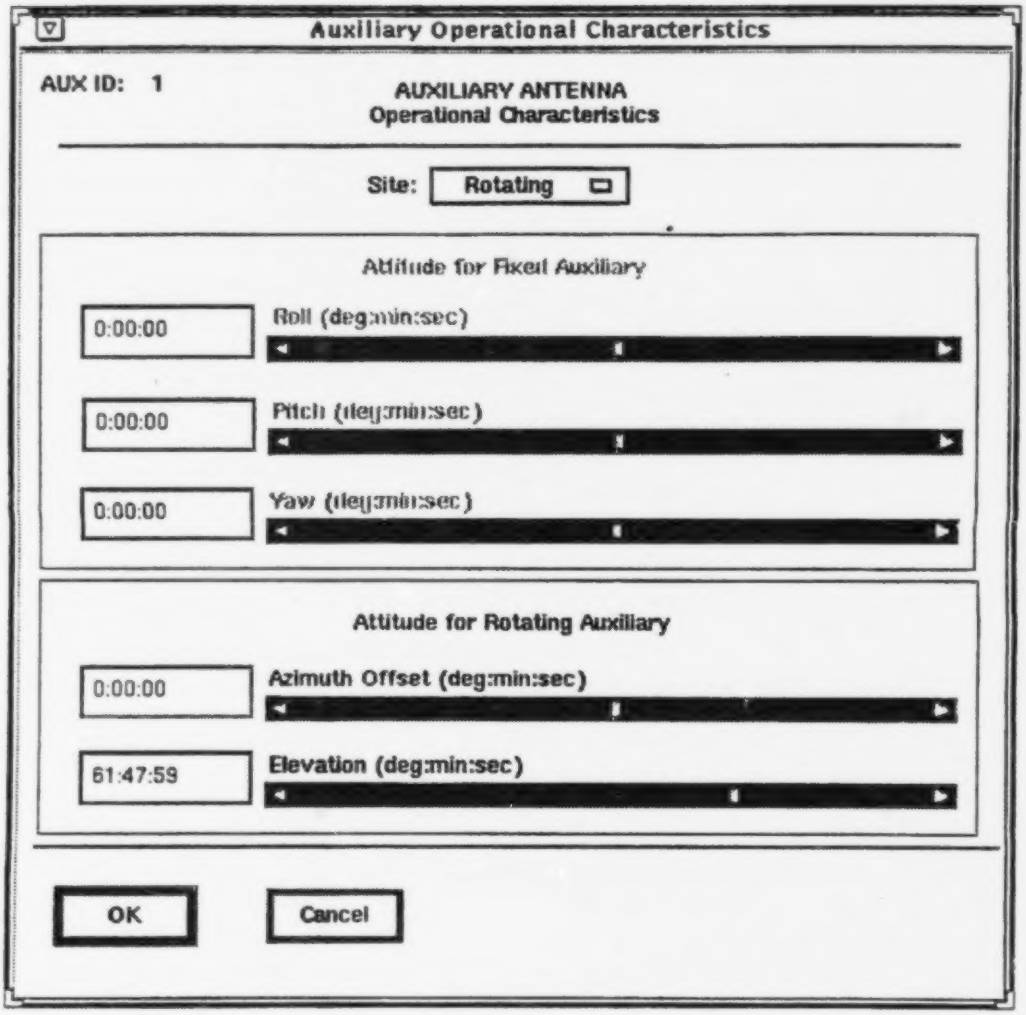
This dialogue is used to specify the orbital position of the SBR satellite. It is accessed from the Satellite/Radar definition top-level by selecting "Orbital Position". The orbit of the SBR is specified in terms of SBR altitude above a spherical earth surface (radius = 6370 .0 km used in calculations), an orbit inclination and satellite direction. Range of values are:

- Altitude: 500 - 10,000 km (default 850 km)
- Orbital inclination: 0 - 90-degrees (90 is polar orbit, default 75°)
- Direction: To North, To South (default to south)

Initial time of day is used to specify a reference time for the beginning of the first burst, but this time does not otherwise affect the calculations. All radar signal calculations of time-of-day are relative to the start of the first burst of the waveform. It is specified as 0-23 h, 0-59 min, 0-59 seconds. Default is zero.

The Initial Sub-Satellite Point (SSP) Location specifies the position of the SBR at the leading edge of the first transmitted burst, and it is used to calculate the subsequent satellite position over the period of the waveform simulated. The initial SSP may be specified by two methods, selected by **Location Method**. If Direct SSP location is selected, the Latitude/Longitude area becomes active and a direct SSP in Lat/long (h:mm:ss format) may be entered. The sign convention is +ve latitude North, +ve longitude East. Default SSP is 0°N/0°E.

If "Derived" is selected (default), the lower area titled Beam Centre Location becomes active and the SBR is positioned in terms of a desired beam centre location (entered as Latitude/Longitude), and desired Azimuth angle (0 - 360 degrees), which is the scan angle that would be observed at the satellite, and the Grazing angle at beam centre (equal to 90 - Incidence angle). Together with the SBR altitude and orbit, the signal generation algorithms will compute the required SSP to give this engagement geometry. Default beam centre is 0°N/0°E, default azimuth is 90° (looking right), and default grazing angle is 6.0°. The SSP is derived in signal generation from the orbit parameter and the specified beam centre. This derived SSP is not displayed in the HMI.



Auxiliary Operational Characteristics

AUX ID: 1

AUXILIARY ANTENNA
Operational Characteristics

Site: Rotating

Attitude for Fixed Auxiliary

Roll (deg:min:sec): 0:00:00

Pitch (deg:min:sec): 0:00:00

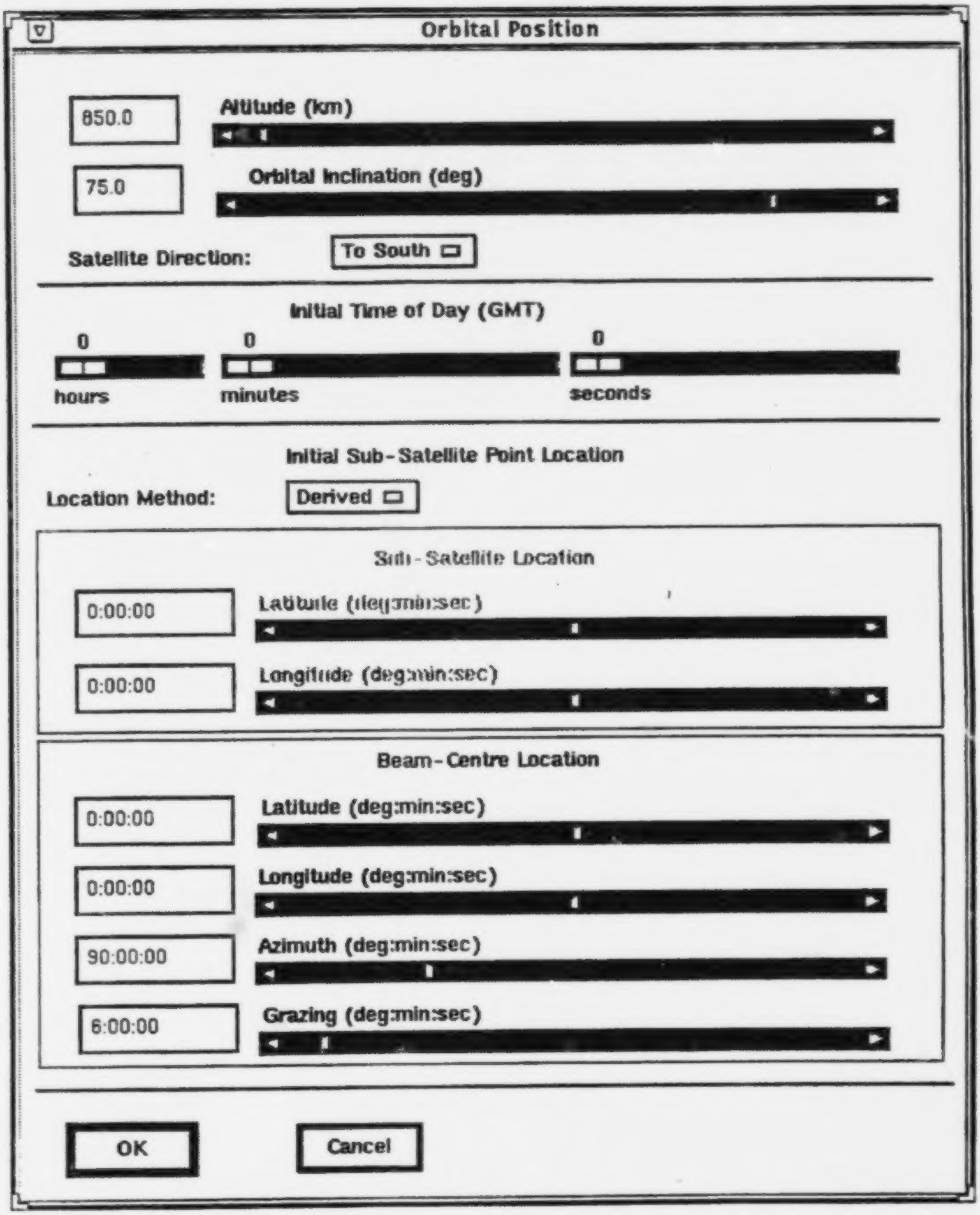
Yaw (deg:min:sec): 0:00:00

Attitude for Rotating Auxiliary

Azimuth Offset (deg:min:sec): 0:00:00

Elevation (deg:min:sec): 61:47:59

Figure B-19 Auxiliary Operational Characteristics Dialogue



Orbital Position

850.0 Altitude (km)

75.0 Orbital Inclination (deg)

Satellite Direction: To South

Initial Time of Day (GMT)

0 hours
0 minutes
0 seconds

Initial Sub-Satellite Point Location

Location Method: Derived

Sub-Satellite Location

0:00:00 Latitude (deg:min:sec)

0:00:00 Longitude (deg:min:sec)

Beam-Centre Location

0:00:00 Latitude (deg:min:sec)

0:00:00 Longitude (deg:min:sec)

90:00:00 Azimuth (deg:min:sec)

6:00:00 Grazing (deg:min:sec)

Figure B-20 Orbital Position Dialogue

B2.7 RSS Data Capture Options

This dialogue is used to specify the intermediate results to be captured in radar signal generation. It is accessed from the Satellite/Radar definition CTI level by selecting "Data Capture Options".

RSS data capture options allows enabling of intermediate results at various stages of signal generation, and choice of main and auxiliary channels to be captured. The dialogue consists of a grid of selector buttons which can be individually toggled on/off. Any combination of channels with products may be enabled. The horizontal dimension represents the channels in signal generation: the channel name and Channel ID are listed across the top. The buttons across the top and down the left side beside "Enable column row" are used to toggle an entire row or column on or off. To toggle any button, position the mouse pointer on the button and click the left mouse button once. All buttons are initially "off" (not-filled or light coloured).

The rows of selector buttons represent the various intermediate signal products listed down. These are briefly identified as follows:

Clutter:	Represents the clutter-only portion of signal generation containing composite response of clutter patches and background clutter.
External Noise:	Represents the simulated external noise added to the signal
Jammers:	Represents the signal generated for each jammer. Each jammer is captured separately and are individually enabled from the Environment Definition file.
Targets:	Represents the signal generated for each discrete target. Each target is captured separately and are individually enabled from the Env Def file.
Composite:	Represents the composite target/clutter/noise/jammer signal, essentially the sum of all the above.
Post-Non-linearity:	Represents the signal after modelling of front-end (RF) non-linearity has been applied.
Post IF Filter:	Represents signal after IF filtering has been applied.
Post Sync Detector:	Represents signal after synchronous I/Q detection.
A/D Output:	Represents the digital sample values after quantization, and is equivalent to the integer I/Q data stored in the SRSD for playback.
Rx Antenna Pattern:	Represents the receive antenna pattern for each main phase centre and auxiliaries, if enabled.

IF Filter Response:	Represents the frequency response of the IF filter model.
Tx Antenna Pattern:	Represent the transmit antenna pattern; there is only one pattern for all the phase centres combined.

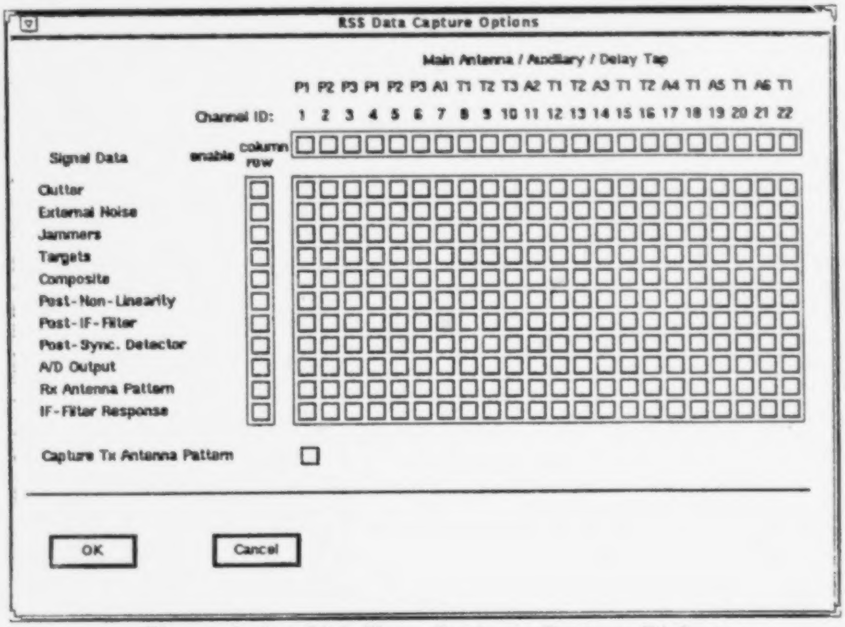

RSS Data Capture Options
Main Antenna / Auxiliary / Delay Tap
P1 P2 P3 P1 P2 P3 A1 T1 T2 T3 A2 T1 T2 A3 T1 T2 A4 T1 A5 T1 A6 T1
Channel ID: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
Signal Data
enable
column
row
Clutter
External Noise
Jammers
Targets
Composite
Post-Non-Linearity
Post-IF-Filter
Post-Sync. Detector
A/D Output
Rx Antenna Pattern
IF-Filter Response
Capture Tx Antenna Pattern
OK
Cancel

Figure B-21 RSS Data Capture Options Dialogue

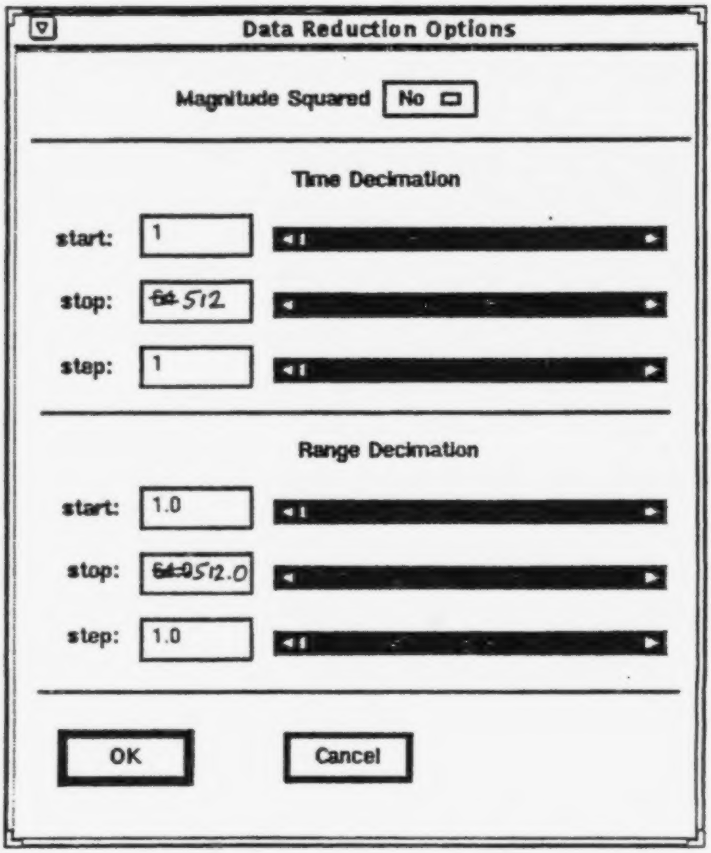
B2.8 Data Reduction Options

This dialogue is used to select data reduction options on the captured RSS intermediate results. It is accessed from the "Data Reductions Options" box in the Satellite/Radar Definition HMI. The data reduction options are used to select reduced sets of the signal data in time and range. These options apply to all signals captured in signal generation.

Magnitude Squared is used to convert complex values to their squared magnitude. "Yes" enables the magnitude-squared reduction and reduces an intermediate result file to 1/2 the size of the complex case.

Time Decimation and Range Decimation are used to select decimation in pulses and range gates, respectively. "Start" indicates the first pulse or range to be captured, counting from "1" upwards. "Stop" similarly indicates the last pulse or range gate to capture, and step indicates the increment. If "1" is selected, the samples are captured at their nominal sample rates. Floating-point inputs are allowed for range decimation since some RSS signals are oversampled in range. The following defaults are provided:

Time:	Start:	1	Stop:	1500.00	Step:	1
Range:	Start:	1	Stop:	512.97	Step:	1



Data Reduction Options

Magnitude Squared No

Time Decimation

start: 1
stop: ~~64~~ 512
step: 1

Range Decimation

start: 1.0
stop: ~~64.0~~ 512.0
step: 1.0

Figure B-22 Data Reduction Options Dialogue

B2.9 Generation Options

This dialogue provides selection of signal generation options, and is accessed from the Satellite/Radar definition by selecting "Generation Options". It provides the following generation options:

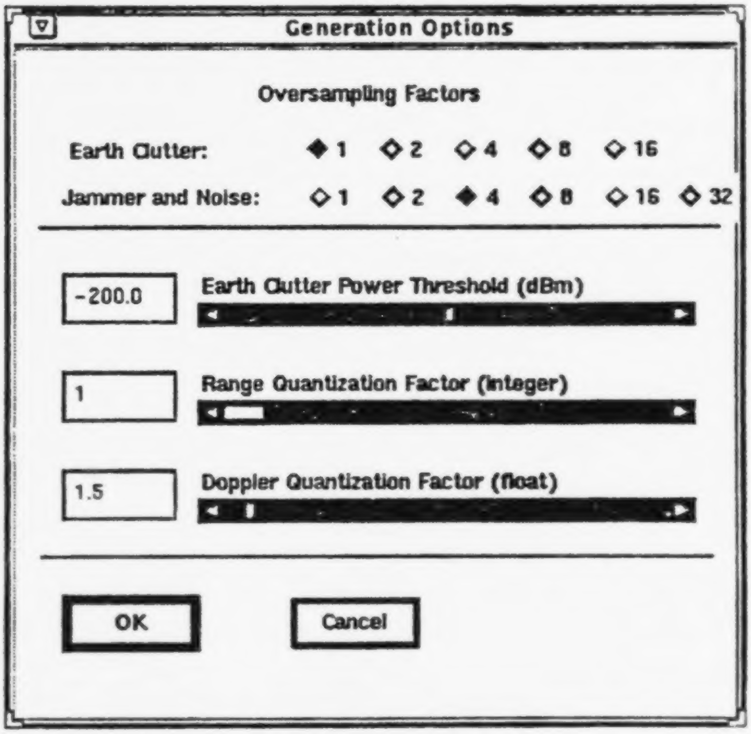
Oversampling Factors

The radar signal simulator oversamples the earth clutter and jammer and noise signals to increase the accuracy of effects modelled on the resulting signals. Earth clutter oversampling is selectable from 1 (default), 2, 4, 8 or 16 times, and jammers and noise oversampling is selectable from 1, 2, 4 (default), 8, 16 or 32 times. The Earth clutter oversampling must be less than or equal to the jammer and noise oversampling.

Earth Clutter Power Threshold is an absolute clutter power threshold (specified in dBm over the range -250 to -150 dBm, default -200 dBm) which determines the minimum power from one clutter cell (more accurately, one range-Doppler grid point of the over sampled array) that will be included in the Earth clutter power summation. A higher value reduces the accuracy of clutter generated, but reduces signal generation time. Since the absolute power from one grid point also depends on the range and Doppler quantization factor, it should be reduced if the quantization factors are increased, e.g.; reduce the threshold by 3 dB if the range or Doppler quantization factor is doubled.

Range Quantization Factor determines the number of clutter patches (or clutter sample points) per range sample used to compute clutter. Increasing the quantization factor will improve the accuracy of signals, but increase the computation time. A range of 1 to 10 (integer) is allowed, and a default value of 1 is provided.

Doppler Quantization Factor determines the number of patches per Doppler bin. The range of Doppler quantization is also 1.0 to 10.0, with a default value of 1.5, and floating-point values are permitted.



Generation Options

Oversampling Factors

Earth Clutter: ◆ 1 ◇ 2 ◇ 4 ◇ 8 ◇ 16

Jammer and Noise: ◇ 1 ◇ 2 ◆ 4 ◇ 8 ◇ 16 ◇ 32

-200.0 Earth Clutter Power Threshold (dBm)

1 Range Quantization Factor (integer)

1.5 Doppler Quantization Factor (float)

Figure B-23 Radar Signal Generation Options Dialogue

B2.10 Dwell Definition

This dialogue is used to specify dwell-dependent parameters for signal generation. It is accessed from the Satellite/Radar definition by selecting the "Location & Waveform Pulse" icon at the dwell level. The beam location and waveform parameters in this dialogue are defined for each dwell - the current dwell is selected by the slider bar and radio buttons in the top-level dialogue. When this dialogue is opened, the dwell identifier is shown in the top left, counting up from "1", the first dwell. Initial definition defaults to dwell 1.

There are a total of three methods of specifying the beam location for each dwell: Direct, Azimuth Grazing, and Boresight Offset. Only one method can be used at a time, indicated by the selection: Location Method.

For the RRA concept, the Direct or Boresight Offset methods are available. If Direct is selected, the beam centre is positioned directly on the Earth surface to the specified latitude and longitude. If "Boresight Offset" is selected, the beam centre is derived from the specified horizontal and vertical offset angles. These angles represent offset angles of the boresight from the main reflector axis.

For the CFA concept, the Direct or Azimuth-Grazing methods can be used. "Direct" functions the same as the RRA case - a beam centre location is specified directly in Earth lat/long coordinates. If "Azimuth Grazing" is specified, the user-entered Azimuth angle (measured w.r.t. the antenna X axis), and beam grazing angle (at the centre of the footprint) are used to derive the location of the beam.

The antenna footprint must lie on the earth, within the field of view of the SBR, and within the scan limits for the RRA or CFA. The RRA scan limits are restricted to a small solid angle about the reflector axis. If scan limits are exceeded, validation or signal generation will report warnings and errors.

Waveform definition at the dwell level provides four parameters:

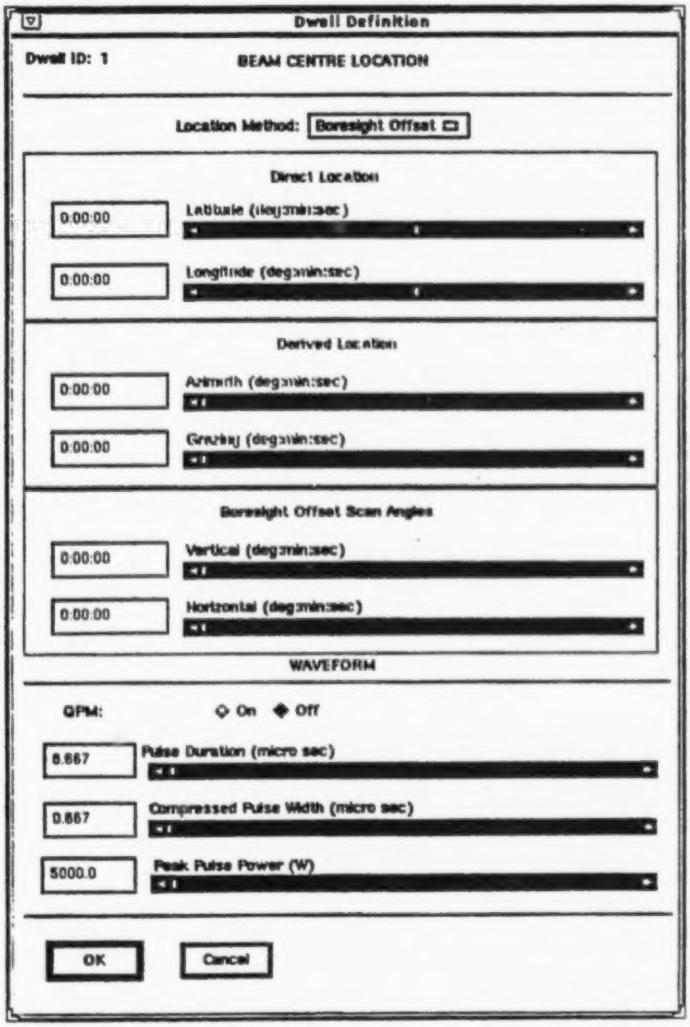
QPM is used to enable quadrature phase modulation in the RRA concept to reduce clutter. It is usually used when the RRA points straight ahead (where relative speed to clutter is greatest).

Pulse Duration specifies the duration of the uncompressed range pulse, in a range of 0.0 to 1000.0 microseconds. The pulse duration may not exceed the PRI for the highest PRF, selected at the NCI level, and it must not exceed 512 range samples (limit in the pulse compression FFT) for the selected range sampling rate. These conditions are not checked when a value is entered here, but will produce a warning or error if validation or signal generation is attempted.

Compressed Pulse Width specifies the 3-dB width of the compressed pulse, and is applicable for LFM and NLFM modulated waveforms. A range of 0.0 to 1000.0 microseconds is allowed. The modulation (FM rate) is derived from the pulse type, transmitted pulse duration and the compressed pulse width. The sampled bandwidth

(Receiver Front End - Bandwidth) should be consistent with the bandwidth of the compressed pulse.

Peak Pulse Power specifies the peak transmitted power radiated over the pulse duration. It is equal to the total radiated power from the aperture; no losses are modelled.



Dwell Definition

Dwell ID: 1

BEAM CENTRE LOCATION

Location Method: Boresight Offset

Direct Location

Latitude (deg:min:sec): 0:00:00
Longitude (deg:min:sec): 0:00:00

Derived Location

Azimuth (deg:min:sec): 0:00:00
Grazing (deg:min:sec): 0:00:00

Boresight Offset Scan Angles

Vertical (deg:min:sec): 0:00:00
Horizontal (deg:min:sec): 0:00:00

WAVEFORM

QPM: ○ On ● Off

Pulse Duration (micro sec): 6.667
Compressed Pulse Width (micro sec): 0.667
Peak Pulse Power (W): 5000.0

Figure B-24 Dwell Definition Dialogue

B2.11 NCI Definition

This dialogue is used to specify the waveform parameters within one non-coherent integration interval. It is accessed from the Satellite/Radar Definition top-level dialogue at the "Waveform PRF" icon.

The NCI parameters are defined for each NCI within each dwell of the waveform. The DI and NCI number is indicated in the upper left corner. The number of NCIs in a dwell is defined in the top level dialogue, and is altered by the "Create - NCI" and "Delete -> NCI" menu bar selections. A default of 3 NCIs/DI is provided for all SBR concepts. Two parameters are defined for the waveform at the NCI level:

Samples per PRI defines an integer number of range samples per pulse repetition interval, and determines the number of range gates in one ambiguous range interval. This sets the number of range gates in the range-Doppler matrix through to the end of NCI processing and detection. A fixed parameter range of 32 ... 1024 samples is provided. The number may be edited by slider bar or direct entry. The radar PRF in kHz (equal to Sampling Rate / Number of Samples per PRI) is computed and displayed for reference.

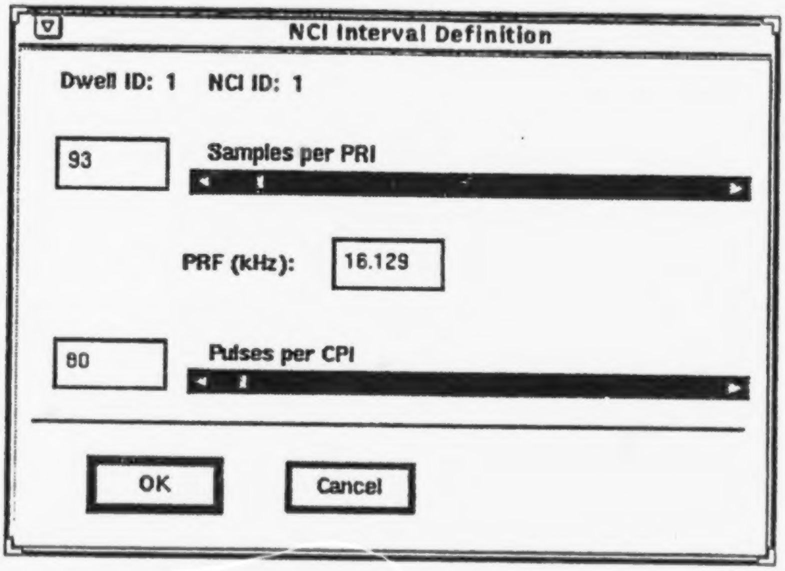
Smart default values are provided for the number of samples in each NCI according to the SBR concept, up to a maximum of 12 NCIs as follows:

RRA:	93, 97, 101, 95, 103, 94, 107, 91, 109, 89, 113, 83
CFA:	217, 221, 225, 223, 218, 211, 209, 227, 229, 233, 239, 241

Pulses per CPI specifies the number of coherent pulses transmitted in one coherent burst in this NCI. A fixed range of 1 to 1500 is provided. The number of pulses per CPI determines the achievable Doppler velocity resolution of the SBR. The number of pulses, samples per pulse, and sampling rate also together set the overall duration of one coherent burst. Smart defaults are provided for each SBR concept as follows:

RRA:	80, 77, 74, 78, 72, 79, 70, 82, 68, 84, 66, 90
CFA:	315, 309, 304, 306, 314, 324, 327, 301, 298, 293, 286, 284

If the SBR concept is changed, the number of samples and number of pulses per NCI will be initialized to the defaults for the new concept.



NCI Interval Definition

Dwell ID: 1 NCI ID: 1

Samples per PRI: 93

PRF (kHz): 16.129

Pulses per CPI: 80

Figure B-25 Non-Coherent Interval Definition Dialogue

B2.12 CPI Definition

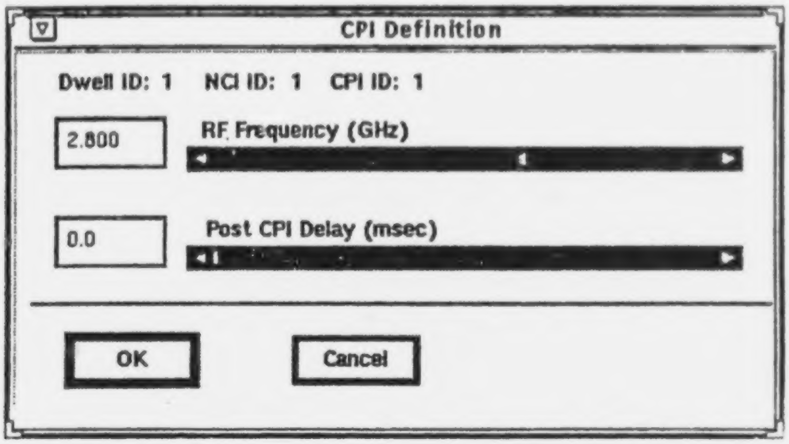
This dialogue is used to specify waveform parameters at the coherent processing, or coherent burst, level. It is accessed from the Satellite/Radar top-level by selecting the "Waveform Frequency" icon. There is a unique definition of CPI parameters for each CPI within each NCI, and within each DI. For RRA, there is a default of 4 CPI/NCI, and for the CFA, a default of 6 CPI/NCI. The dwell, NCI and CPI numbers are indicated in this dialogue. There are two parameters changeable at the CPI level:

RF Frequency specifies the transmitter carrier frequency (bandcentre for modulated waveforms) for the coherent burst. A fixed range of 1.0 to 4.0 GHz is allowed. Smart defaults are provided dependent on the SBR concept:

RRA:	2.80, 2.93, 3.07, 3.20 GHz
CFA:	1.20, 1.24, 1.28, 1.32, 1.36, 1.40 GHz

with the sequence repeated as necessary for the number of CPIs in the NCI.

Post CPI Delay is used to specify a transmit quiet period after the end of a coherent burst for non-range eclipsing waveforms. A fixed range of 0 - 200 ms is allowed. By entering a delay greater than or equal to the round-trip time to beam centre, eclipsing of the received signal is avoided. The post-CPI delay is unique for each burst within the waveform, allowing interleaving of any number of coherent bursts with interburst receive periods.



Dwell ID: 1 NCI ID: 1 CPI ID: 1

RF Frequency (GHz): 2.800

Post CPI Delay (msec): 0.0

Figure B-26 Coherent Processing Interval Definition Dialogue

APPENDIX C

ENVIRONMENT HMI

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APPENDIX C

ENVIRONMENT HMI

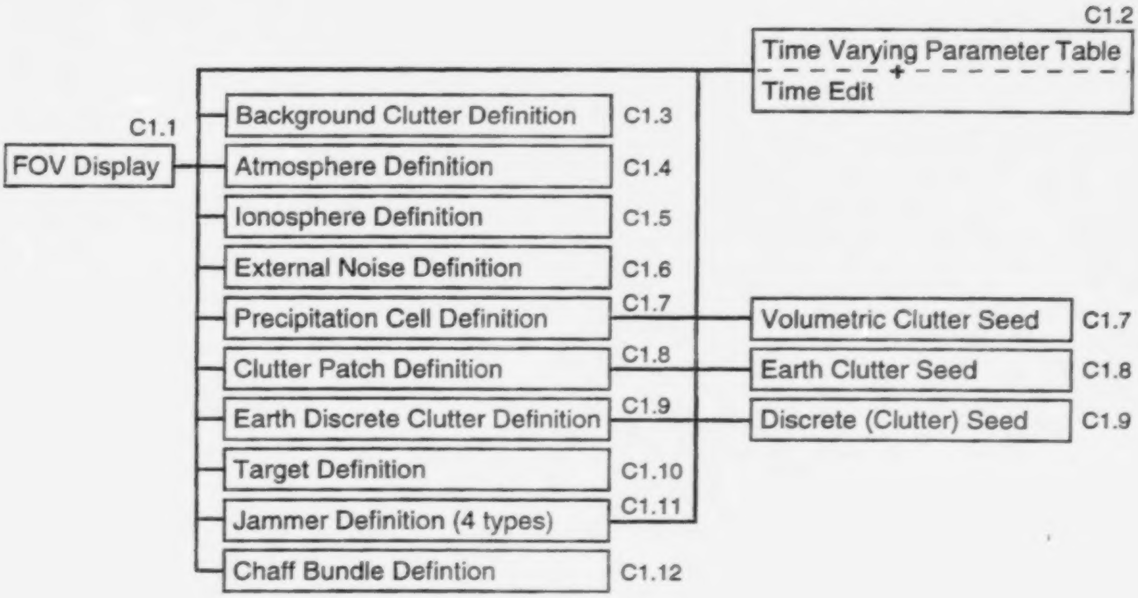
C1. ENVIRONMENT HMI

The SPD Environment HMI is used to define the radar environment consisting of targets, clutter, jammers, noise and propagation effects. In the SPD, the concept of radar environment is separated from the Satellite/Radar definition to allow different combinations of satellite definitions and environment definitions to be used to compare performance. The Environment HMI uses a hierarchy of dialogue boxes similar to the Satellite/Radar Definition. Each lower-level dialogue contains a set of functionally-related parameters. Figure C-1 illustrates that hierarchy of dialogues. The environment parameters defined in the HMI are stored in a file with a default file extension of *.env_def*, and then may be selected in the Signal Generation HMI when signal generation is performed.

C1.1 FIELD OF VIEW TOP-LEVEL DIALOGUE

The Field Of View (FOV) Display (see Figure C-2) is the top-level environment HMI dialogue that is first presented when the HMI is activated. The HMI can be started from the command (*envdef*) or from the environment HMI icon.

This dialogue contains iconic representations of the lower-level environment definition dialogues used to enter and edit parameters, a list of targets, jammers and clutter, and a menu bar selection of file related functions. A separate display will be provided to graphically depict the locations of the objects in relation to the SBR within the field of view.


C1.2
Time Varying Parameter Table
Time Edit
C1.1
FOV Display
Background Clutter Definition
C1.3
Atmosphere Definition
C1.4
Ionosphere Definition
C1.5
External Noise Definition
C1.6
Precipitation Cell Definition
C1.7
Volumetric Clutter Seed
C1.7
Clutter Patch Definition
C1.8
Earth Clutter Seed
C1.8
Earth Discrete Clutter Definition
C1.9
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C1.9
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Jammer Definition (4 types)
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Chaff Bundle Defintion
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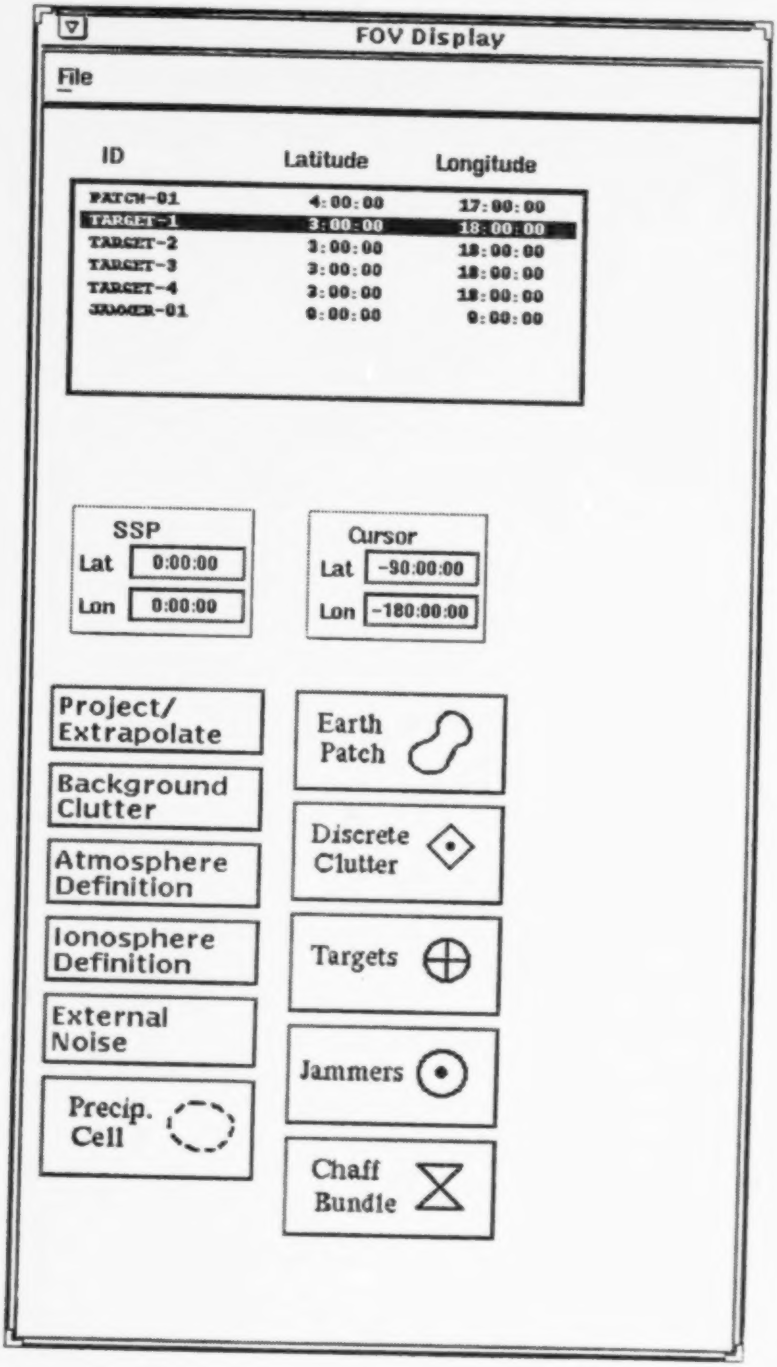
AI-7775-D7/CW

Figure C-1 Environment Definition Dialogue Hierarchy Diagram


FOV Display
File
Project/ Extrapolate
Background Clutter
Atmosphere Definition
Ionosphere Definition
External Noise
Precip. Cell
Earth Patch
Discrete Clutter
Targets
Jammers
Chaff Bundle

ID	Latitude	Longitude
PATCH-01	4:00:00	17:00:00
TARGET-1	3:00:00	18:00:00
TARGET-2	3:00:00	18:00:00
TARGET-3	3:00:00	18:00:00
TARGET-4	3:00:00	18:00:00
JAMMER-01	0:00:00	0:00:00

SSP
Lat 0:00:00
Lon 0:00:00

Cursor
Lat -90:00:00
Lon -180:00:00

Figure C-2 Environment Definition (Field of View) Top-Level Dialogue

C1.1.1 Pull-Down Menu Bar

The pull-down menu bar provides the following environment definition file related functions to load and save definition data to the file system. File functions consist of the following:

New:	Initializes a new definition (in-memory data structures) with default values.
Open:	Open a previously saved environment definition file
Save:	Save the current in-memory environment definition to the current definition file (defined in a previous "open"). If no filename is defined, a File Selection pop-up dialogue will be opened to prompt for a filename.
Save As:	Save the current in-memory definition to a named or new file; the File Selection pop-up is presented in response.
Load Radar:	This selection is used to specify and load a satellite/radar definition file for the purpose of computing the time-varying parameters under Project/Extrapolate. The environment definition is not altered by loading a Satellite/Radar definition.
Exit:	Exit from the environment definition HMI; this will prompt for confirmation before the HMI program quits.

C1.1.2 Object List

The FOV display provides a tabular list of all targets, jammers, clutter patches and discrete clutter defined in the current radar environment. **ID** indicates an alphanumeric object identifier, which is specified when the target, jammer or clutter element is added to the environment. **Latitude/longitude** indicates the position of the object on the earth surface in the definition data. Targets, jammers and discrete are defined for a single point; for clutter patches which are defined by geographic vertices, only the first vertex is displayed.

C1.1.3 SSP and Cursor

The Sub-Satellite Point (SSP) indicates the sub-satellite point of the SBR, defined in a Satellite/Radar definition, and loaded using "Load Radar" above. This coordinate is used in the calculation of the time-varying parameters, and to depict the SSP in the graphical FOV. If a Satellite/Radar definition is not loaded, this parameter defaults to 00:00:00N/00:00:00E. The cursor position indicates the current position of the pointer in the graphical field of view display. If the graphical FOV is not active, this value is not used.

C1.1.4 *Environment Dialogue Icons*

The titled icons (or boxes) below SSP/cursor provide access to the lower-level environment dialogues to enter and edit parameters. The following are provided:

Project/Extrapolate:	Compute time-varying parameters for a loaded satellite/radar definition.
Background Clutter:	Define background clutter
Atmosphere Definition:	Define tropospheric propagation parameters
Ionosphere Definition:	Define ionospheric propagation parameters
External Noise:	Define external noise characteristics
Precip. Cell:	Define a volumetric precipitation cell element
Earth Patch:	Define a clutter patch on the earth surface
Discrete Clutter:	Define a discrete clutter element
Targets:	Define a moving target
Jammer:	Define a jammer (fixed or moving)
Chaff Bundle:	Define a volumetric chaff element

C1.2 PROJECT/EXTRAPOLATE (TIME-VARYING PARAMETERS TABLE)

This dialogue is used to compute a number of time-varying parameters of objects modelled in the field of view. These parameters indicate the motion of objects being simulated and some of their time-varying characteristics such as range and Doppler bin. It can be used in conjunction with the object definitions to place objects with very specific radar parameters (e.g. to position a target or jammer in a specific range/Doppler bin) The dialogue is accessed from the top-level dialogue through the "Project/Extrapolate" icon, and may also be invoked from the Target Definition and Jammer Definition dialogues. Project/extrapolate object parameters is only possible after a related satellite/radar definition has been loaded.

Project/Extrapolate operates in the following manner: when it is selected, two dialogue boxes are opened: **Time Edit** (Figure C-3) and **Time Varying Parameters Table** (Figure C-4). The Time-Varying Parameter Table (TVPT) subdialogue box indicates the time-dependent parameters for a specified dwell, NCI and CPI, and is initially empty. The desired interval in the waveform is specified in the **Time Edit** subdialogue using the slider bars or direct editing to choose a valid dwell, NCI, and CPI in the waveform defined in the Satellite/Radar definition. Pressing **apply** uses the selection to compute the time-varying parameters for the selected object defined in the radar environment. The TVPT information is derived from the object definition and the satellite/radar parameters, and is display-only. The button **clear** is used to erase previous calculations without closing the dialogue. To compute the time-varying parameters for another object, first select that object in the object list in the top-level dialogue, and then do **apply** in the Time Edit dialogue. To exit from the Project/Extrapolate function, select **close** in the Time Edit dialogue; the Time Edit and TVPT will be closed.

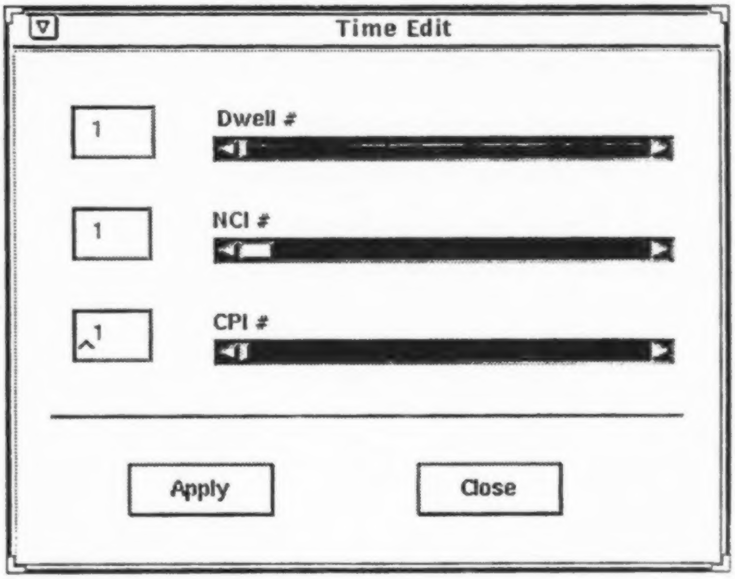
While the TVPT is open, object parameters can be edited and updated, and **apply** used to recompute the time-varying parameters with the new object values. This can be used to adjust the position, speed and heading of targets and jammers to place them in specific geographic locations, or specific range/Doppler bins in a CPI. To edit an object, select and open its dialogue while TVPT is open. Edit the desired parameters and use **apply** in that dialogue to apply the change to the in-memory definition.

Satellite/Radar definition parameters can also be changed while Project/Extrapolate is open, and used to recompute time-varying values for a new satellite/radar configuration. To do this, the satellite/radar definition is opened and edited, then saved to file. To apply the changes to the TVPT, the edited satellite/radar definition file is then reloaded by selecting Load Radar in the environment definition, and **apply** selected in Time Edit to recompute the values.

TVPT computes and displays the following information:

TOD:	Time of Day is the exact time-of-day (GMT) of the indicated CPI to the nearest millisecond.
Lat/long:	Indicates the latitude/longitude (hh:mm:ss) of the object at the indicated time, computed to the nearest second of arc. Sign convention is the same as satellite/radar and object definition.
Azimuth:	Indicates the target azimuth in decimal degrees relative to the direction of travel of the SBR, measured from the SBR, for the indicated interval. Valid range is -180 to 180 degrees.
Graze:	Indicates the object grazing angle in decimal degrees, observed at the target, for the indicated interval. Valid range is 0 to 90 degrees.
Range:	Unambiguous range in km from SBR to object for the indicated interval, computed using the spherical earth assumption, as used in signal generation.
Dop.	Doppler shift of object in Hz, observed for the indicated interval, accounting for target radial speed and radar parameters in the interval.

Gate:	Indicates nearest integer range gate of object for the indicated interval, counting from 0 to N_r-1, where N_r = number of range gates.
Dop. Bin	Indicates nearest integer Doppler bin of object for the indicated interval, counting from 0 to N_{pd}-1, where N_{pd} = pulse Doppler FFT length. The Doppler bin calculated applies to the output of pulse Doppler, and before any Doppler augmentation or velocity bin resampling in the RSP.
Gain	Indicates the antenna gain in the direction of the object, relative to an isotropic (unity gain) antenna.

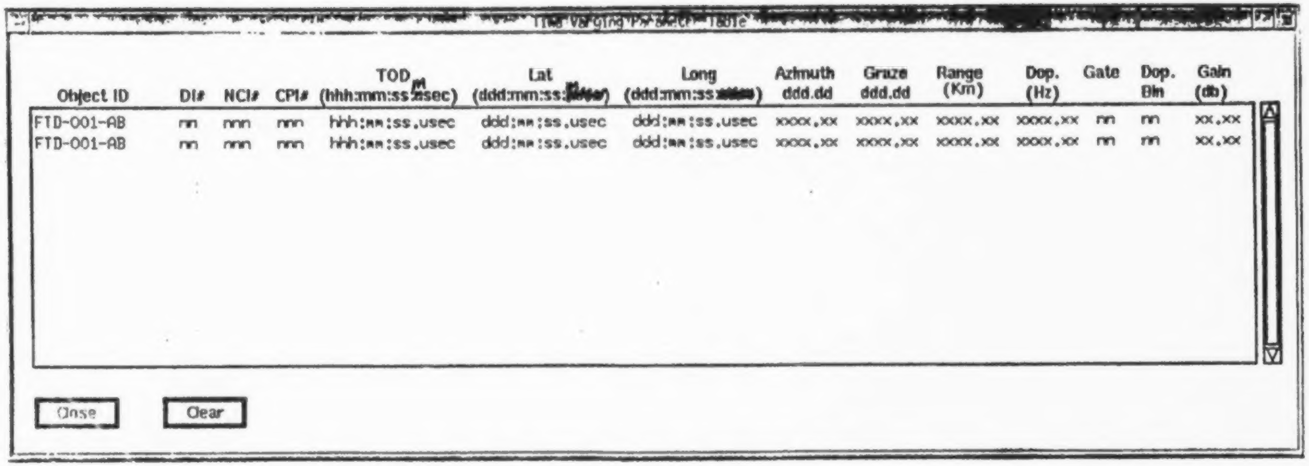


Dwell # 1

NCI # 1

CPI # 1

Figure C-3 Project/Extrapolate Time Edit Dialogue



Object ID	DI#	NCI#	CPI#	TOD (hhh:mm:ss:usec)	Lat (ddd:mm:ss:[illegible])	Long (ddd:mm:ss:[illegible])	Azimuth ddd.dd	Graze ddd.dd	Range (Km)	Dop. (Hz)	Gate	Dop. Bin	Gain (db)
FTD-001-AB	nn	nnn	nnn	hhh:mm:ss,usec	ddd:mm:ss,usec	ddd:mm:ss,usec	xxxx,xx	xxxx,xx	xxxx.xx	xxxx.xx	nn	nn	xx.xx
FTD-001-AB	nn	nnn	nnn	hhh:mm:ss,usec	ddd:mm:ss,usec	ddd:mm:ss,usec	xxxx,xx	xxxx,xx	xxxx.xx	xxxx.xx	nn	nn	xx.xx

Figure C-4 Project/Extrapolate Time Varying Parameters Table Display

C1.3 BACKGROUND CLUTTER DEFINITION

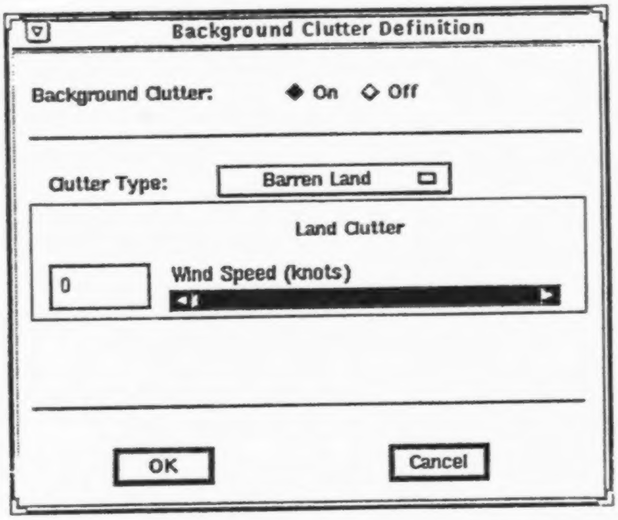
This dialogue is used to specify the background clutter type over the field of view. It is applicable for the full CTI (duration of the waveform).

On/Off is used to enable or disable background clutter. Enabling background clutter will significantly increase signal generation time, compared to no clutter. For initially setting up scenarios, it is recommended that background clutter be turned off.

Five types of terrain type are provided, selectable by **Clutter Type**. The choices are:

Sea	(specify wind direction in degrees, and sea state)
Barren Land	(specify wind speed in knots)
Vegetated Land	(same)
Urban Land	(same)
Snow Covered Land	(same)

Except for sea clutter, the type of terrain affects the level of backscatter, and the wind speed affects the spectral width (see Figure C-5a). Wind speed is entered in the range 0 - 100 knots, and direction is not required. Internal motion of the clutter is modelled based on the wind speed only.



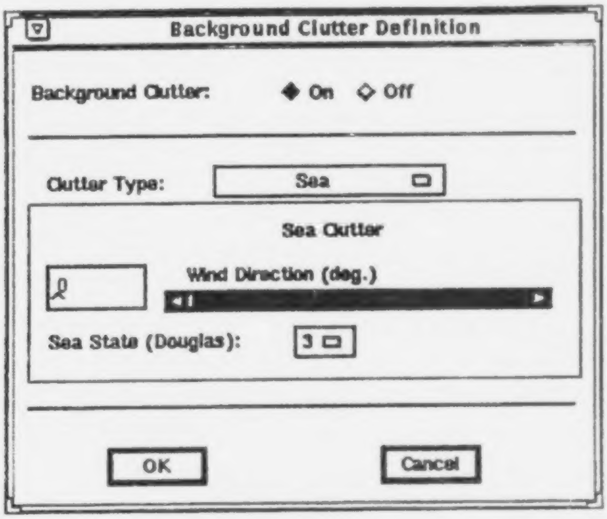
Background Clutter: ◆ On ◇ Off

Clutter Type: Barren Land

Wind Speed (knots): 0

Figure C-5a Background Clutter Definition Dialogue - Land Clutter Type

In the case of Sea type (Figure C-5b), wind direction only affects the spectral position of the sea backscatter. More subtle variations in Sea Clutter power and statistical variance are not modelled. Wind direction is specified over the range 0 -360 degrees (default zero), relative to North, and is used to determine the direction of dominant wave motion. The usual sense of wind direction is assumed (value is direction *the wind blows from*.) Sea state specifies the sea state as Douglas number 0 (calm) to 5 (roughest sea). Default sea state is 3.



Background Clutter Definition

Background Clutter: ◆ On ◇ Off

Clutter Type: Sea

Sea Clutter

Wind Direction (deg.): 0

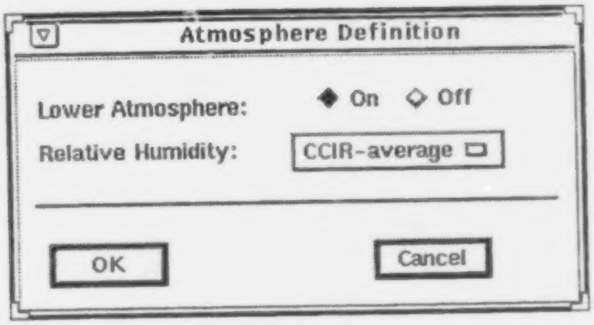
Sea State (Douglas): 3

Figure C-5b Background Clutter Definition Dialogue - Sea Clutter Type

C1.4 ATMOSPHERE DEFINITION

This dialogue (Figure C-6) is used to specify parameters in the lower atmospheric model. It is accessed from the top-level dialogue by selecting Atmosphere Definition.

The lower atmospheric effects are modelled as a relative humidity vs altitude profile which is uniform over the field of view. The principal effects are tropospheric refraction, which can influence the observed range and Doppler of targets and attenuation due to 0_2 and water vapour. The model is enabled by selecting Lower Atmosphere "On". Selecting "Off" disables the model. If enabled, the Relative Humidity selection becomes active and two choices are provided: CCIR-Average and 100%. "CCIR average" selects an average exponential troposphere model as described in CCIR Report: "Propagation in Non-Ionized Media" (R-22). "100%" selects a polynomial refractivity model for 100% relative humidity as described by Millman (R-23). For further details on the refraction and attenuation models also see Appendix J, Section J.10, of the Testbed Preliminary Design (R-13).



Lower Atmosphere: ◆ On ◇ Off

Relative Humidity: CCIR-average

Figure C-6 Atmosphere Definition Dialogue

C1.5 IONOSPHERE DEFINITION

This dialogue (Figure C-7) is used to specify parameters in the ionospheric model. It is accessed from the Ionospheric Definition icon in the top-level dialogue.

The ionospheric model consists of three main effects: scintillation, Faraday rotation and attenuation. The ionospheric electron density profile is modelled using the Chapman profile. For details, refer to Appendix J of the Testbed Preliminary Design, Section J.13 "Ionosphere Model" (R-13) and CCIR Report: "Propagation in Ionized Media" (R-24). Parameters are as follows:

Electron Density specifies the electron density at the level of maximum ionization, and is entered as a value in the range 10^9 to 10^{14} electrons per m^3. Default is 10^9

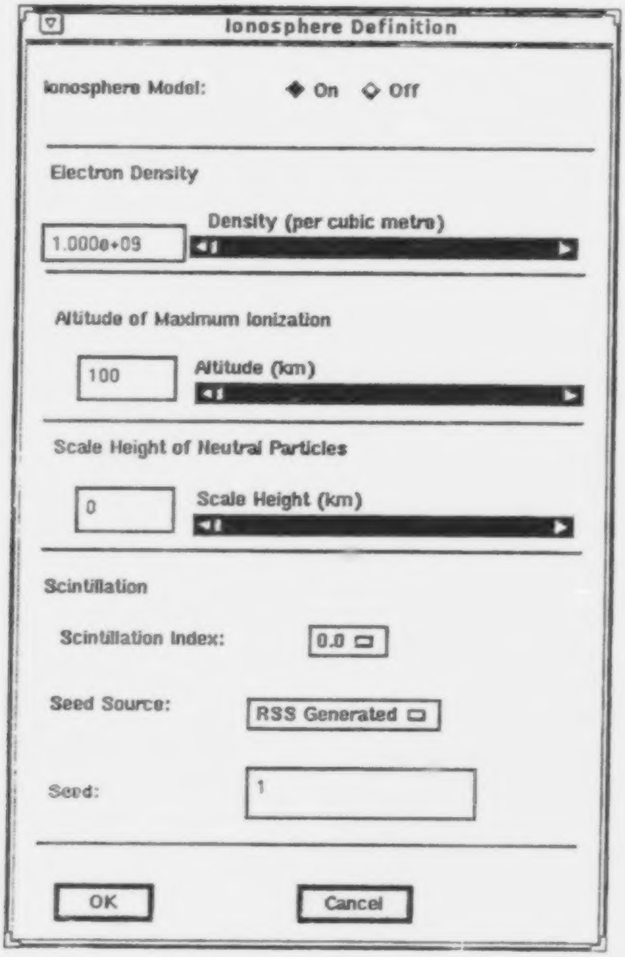
Altitude of Maximum Ionization specifies the altitude from 100 to 300 km of maximum ionization. Default is 100 km.

Scale Height of Neutral Particles is entered as an altitude from 0 to 50 km. Default is zero.

Scintillation Index provides six discrete choices of ionospheric scintillation: 0.0, 0.1, 0.2, 0.3, 0.4 and 0.5. Default is zero.

Seed Source allows choice of a predefined RSS random seed or user-entered value to initialize the scintillation random process. If RSS Generated is selected, a constant seed is used meaning repeated runs generate the same random sequence. User-Specified activates the Random Seed numerical input, and the user may enter a random seed: 1 to 2^{32}-1, useful for repeated runs with different seeds to get statistically significant results.

Note: In SPD Version 4.1 (November 1994), the ionospheric models are not implemented. The software has been partially coded, but not tested or integrated.



Ionosphere Model: ◆ On ◇ Off

Electron Density

Density (per cubic metre): 1.000e+09

Altitude of Maximum Ionization

Altitude (km): 100

Scale Height of Neutral Particles

Scale Height (km): 0

Scintillation

Scintillation Index: 0.0

Seed Source: RSS Generated

Seed: 1

Figure C-7 Ionosphere Definition Dialogue

C1.6 EXTERNAL NOISE DEFINITION

This dialogue (Figure C-8) is used to specify the external noise parameters. It is accessed from the External Noise icon in the top-level environment dialogue.

External noise (principally Earth black-body radiation and galactic sources) are modelled by a non-zero noise temperature, added to the receiver noise temperature to obtain a total noise power figure. If External Noise Model is set to "Off", then this external noise term is set to zero and only receiver noise temperature determines total noise power. If the external noise is "On", then external noise temperature (T_{ext}) is set according to the following rules:

a. If background clutter type is Sea, T_{ext} = 180 degrees K
b. Otherwise, for land background types, T_{ext} = 240 deg K.

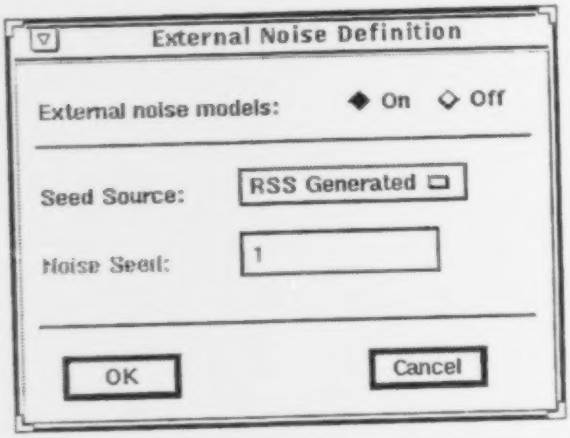
The total noise power is computed according to:

$$P_n = k F_s O_v (T_{rx} + T_{ext})$$

where:

k = Boltzmann's constant
F_s = sampling frequency
O_v = noise oversampling factor
T_{rx} = receiver noise temperature (specified for each main and auxiliary in Satellite/Radar Definition)
T_{ext} = external noise temperature according to above

If External Noise is On, a random seed for the external noise process may be defined as either RSS-Generated or User-Specified. This operates in the same way as the other random seeds.


External Noise Definition

External noise models: ● On ○ Off

Seed Source: RSS Generated

Noise Seed: 1

Figure C-8 External Noise Definition Dialogue

C1.7 PRECIPITATION CELL DEFINITION

This dialogue (Figure C-9) is used to specify the parameters of precipitation cell modelling. It is accessed from the top-level environment dialogue by selecting the "Precip. Cell" icon.

Precipitation cells are modelled as a circular cylindrical precipitation volume of uniform composition centered on a given geographic location. For details on precipitation cell models, refer to Appendix J.7, "Precipitation and Chart Computations", Testbed Preliminary Design (R-13).

Note: *In SPD Version 4.1 (November 1994), the precipitation cell models are not implemented.*

Latitude/longitude define the centre location of the cell in geographic coordinates. The usual conventions for latitude/longitude are followed. (Default is 0°N/0°E)

Water State allows specification of four types of moisture in the volume: Rain, Snow, Fog, Cloud. Changing the water state will reinitialize values for Upper Altitude and Quantity of Water to default values for the new state. (Default is "Rain")

Lower Altitude is enabled for cloud only, allowing specification of the height of cloud bottom over the range 0 - 8000 m, with a default of 600 m.

Upper Altitude specifies the top of the precipitation cell, and is selectable over the range 0 - 8000 m for rain, snow and cloud (default value 4000 m), and over the range 0 to 100 m for fog (default value 50 m). The upper altitude must exceed the lower altitude.

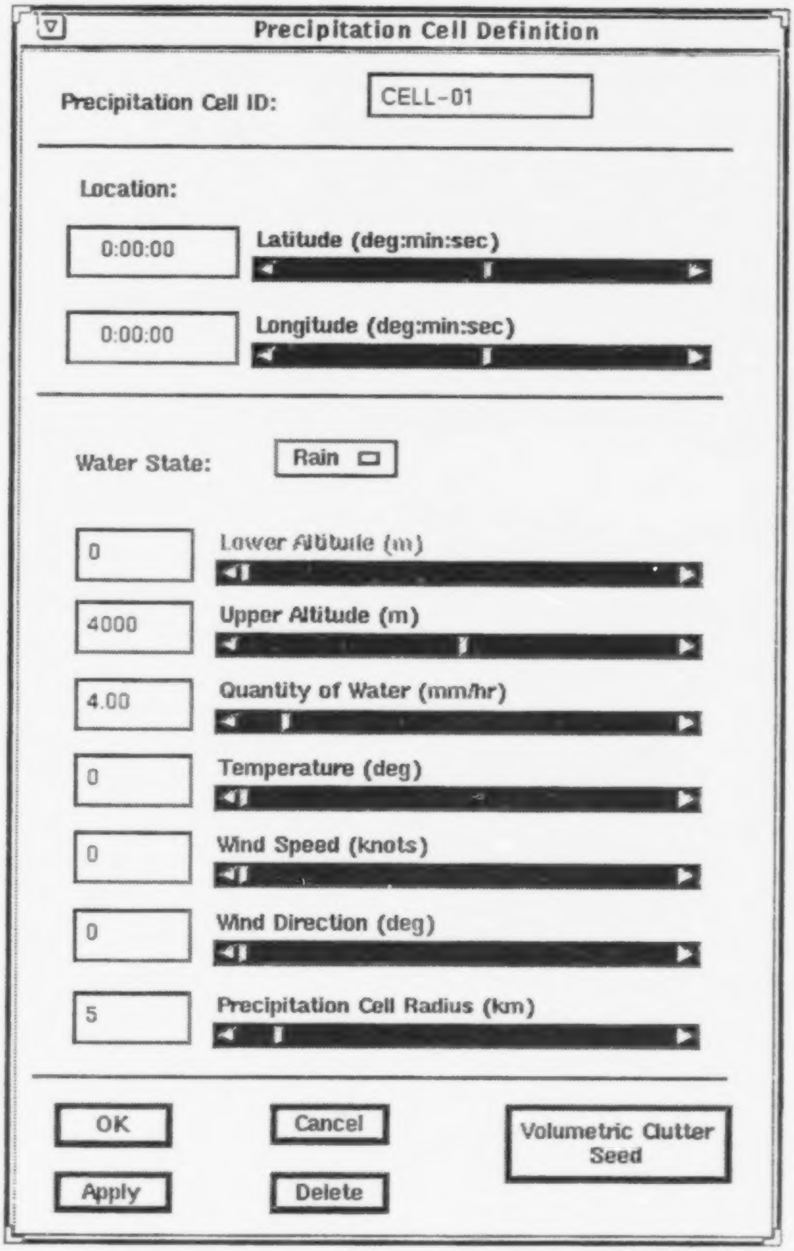
Quantity of Water specifies the water concentration in the precipitation cell, assumed to be constant throughout. If rain or snow is selected, the quantity of water is specified as a precipitation rate in mm/hr. If fog or cloud is selected, the concentration is given in gm/m^3. Valid range and defaults are as follows:

Type	Range	Default
Rain	0.25 - 40 mm/hr	4 mm/hr
Snow	0.025 - 4 mm/hr	0.4 mm/hr
Fog	0.04 - 2.3 gm/m^3	0.15 gm/m^3
Cloud	0.5 - 2.5 gm/m^3	0.8 gm/m^3

Temperature specifies the temperature in degrees Celsius in the precipitation cell. For snow, the range is -40 to 0 deg-C, and for others the range is 0 to 40 deg-C. Default is zero degrees C.

Wind Speed specifies the wind speed in knots, from 0 to 100 knots, and **Wind Direction** specifies the direction of the wind (0 - 360 degrees), in the usual convention. Defaults are zero.

Volumetric Clutter Seed is used to open a sub-dialogue (Figure C-10) to specify a random seed value for the random process used in the precipitation cell model. RSS-Generated will produce a repeatable run, while User-Specified allows a positive integer to be entered, allowing repeated runs with different seeds, to produce statistical average results.


Precipitation Cell Definition
OK
Cancel
Apply
Delete
Volumetric Clutter Seed

Precipitation Cell ID: CELL-01

Location:

Latitude (deg:min:sec): 0:00:00

Longitude (deg:min:sec): 0:00:00

Water State: Rain

Lower Altitude (m): 0

Upper Altitude (m): 4000

Quantity of Water (mm/hr): 4.00

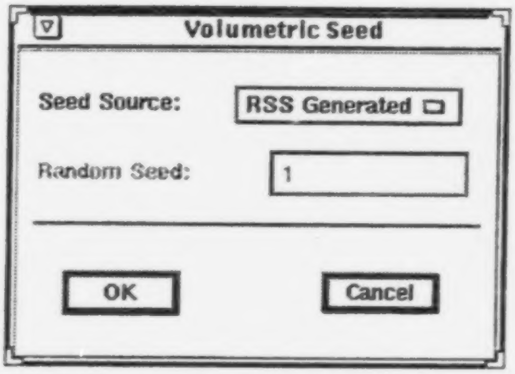
Temperature (deg): 0

Wind Speed (knots): 0

Wind Direction (deg): 0

Precipitation Cell Radius (km): 5

Figure C-9 Precipitation Cell Definition Dialogue



Seed Source: RSS Generated

Random Seed: 1

Figure C-10 Volumetric Clutter Seed Subdialogue

C1.8 EARTH CLUTTER PATCH DEFINITION

This dialogue (Figure C-11a, b) allows specification of clutter patches on the earth surface for the purpose of defining local areas of clutter. This dialogue is accessed from the "Earth Patch" icon in the environment dialogue.

Clutter patches are modelled as polygons of a uniform specific terrain type. The vertices are entered by geographic coordinates in a list. In the present implementation, only convex polygons are permitted due to the type of rasterizing algorithm used to map the polygon into the range/Doppler grid for signal generation. A valid clutter patch must have a minimum of three vertices. For details on earth clutter patch calculations, refer to Appendix J.5 "Earth Clutter Patch Area Calculation", in the Testbed Preliminary Design (R-13). For details on the terrain model characteristics, see J.8 "Earth Clutter Model Assignment" of the same document.

Clutter Patch ID displayed at the top of the dialogue identifies the clutter patch. The default names for patches start with "PATCH-01" and count up (-02, -03, ...) for each patch added. This name is arbitrary and may be changed to any name that doesn't conflict (match with) any other object defined.

Latitude/longitude are used to enter or edit the geographic coordinate of a vertex. To add a new vertex, select "Insert" and a new vertex will be added to the list, with a default value that preserves a convex polygon. The latitude/longitude may be changed with the slider bar, but the coordinate must be such that the polygon remains convex. A warning message, "Invalid clutter patch vertex specified..." will be displayed if the resulting polygon is concave.

"Apply" applies the changes to the indicated vertex, and if valid, the coordinate is saved in the in-memory structure defining the clutter patch. "Delete" is used to delete the currently selected vertex. When deleting vertices, be sure that the convex criteria remains satisfied, otherwise, an error will occur.

Clutter Type is used to select the terrain type in the clutter patch, assumed to be uniform throughout. Five choices are provided, similar to background clutter (the same terrain reflectivity models are used for both cases):

- Sea (see Figure C-11a)
- Barren Land (see Figure C-11b)
- Vegetated Land
- Urban Land (default)
- Snow Covered Land

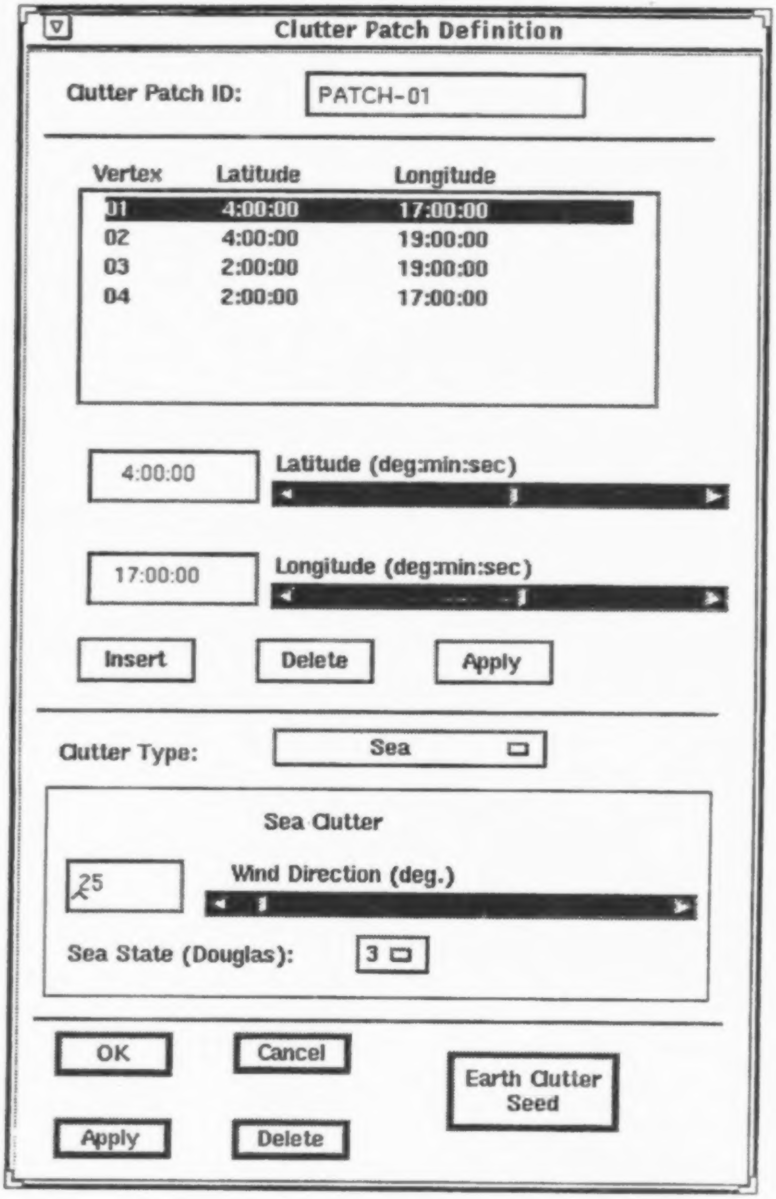
For land types, the wind speed is specified in the range 0 - 100 knots (default zero). This determines resulting internal motion for land types, and the induced spectral width of clutter Doppler. For a sea clutter patch, wind direction (w.r.t. North) and sea state on the Douglas scale from 0 to 5 is specified (default is 3).

Earth Clutter Seed opens a sub-dialogue to prompt for a seed value for the random process used to model the clutter patch. Similar to previous cases, the random seed may be either RSS-Generated, meaning the random process is repeated exactly each run, or User-Specified, in which case, the user entered value is used to initialize the clutter random process for this clutter patch.

Overlaid Clutter Patches. Convex clutter patches may overlap one another on the Earth's surface. This may be done intentionally, for example, to simulate islands in a larger water body, or lakes within a land mass. The order of overlapping is such that the last clutter patch defined will be on top, and override a previous patch. This occurs as a result of the rasterizing process which rasterizes the clutter patches in the order they are defined.

C1.8.1 Earth Clutter Seed Subdialogue

This dialogue (Figure C-12) is used to specify a random seed value for the random process used in the clutter patch model. Selecting "RSS Generated" will use a preset constant as the seed value, providing exact repeatability of the random process used to model this clutter patch. "User-Specified" allows selection of different values for statistically different runs.


Clutter Patch Definition
Insert
Delete
Apply
Sea Clutter
OK
Cancel
Apply
Delete
Earth Clutter Seed

Clutter Patch ID: PATCH-01

Vertex	Latitude	Longitude
01	4:00:00	17:00:00
02	4:00:00	19:00:00
03	2:00:00	19:00:00
04	2:00:00	17:00:00

Latitude (deg:min:sec): 4:00:00

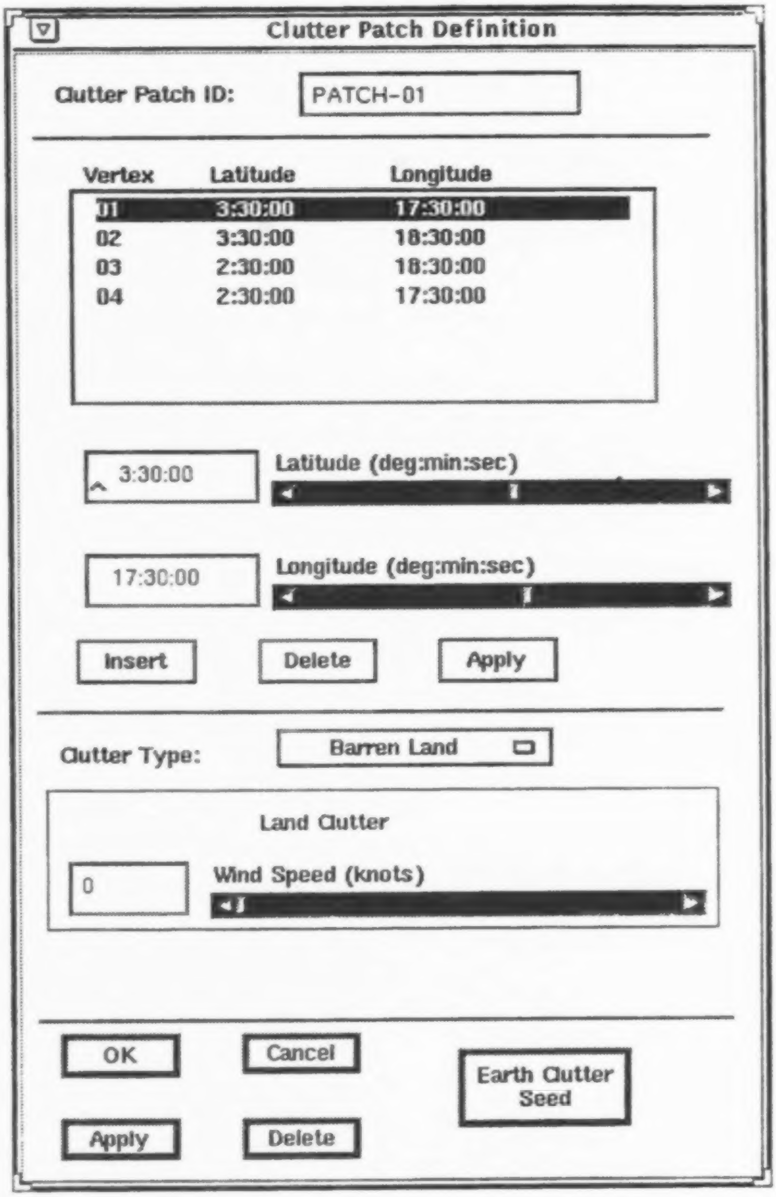
Longitude (deg:min:sec): 17:00:00

Clutter Type: Sea

Wind Direction (deg.): 25

Sea State (Douglas): 3

Figure C-11a Clutter Patch Definition Dialogue - Sea Clutter


Clutter Patch Definition
Insert
Delete
Apply
Land Clutter
OK
Cancel
Apply
Delete
Earth Clutter Seed

Clutter Patch ID: PATCH-01

Vertex	Latitude	Longitude
01	3:30:00	17:30:00
02	3:30:00	18:30:00
03	2:30:00	18:30:00
04	2:30:00	17:30:00

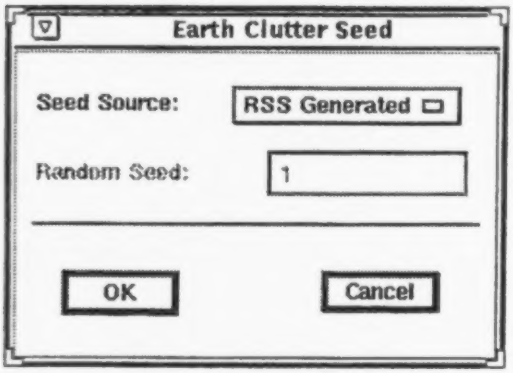
Latitude (deg:min:sec): 3:30:00

Longitude (deg:min:sec): 17:30:00

Clutter Type: Barren Land

Wind Speed (knots): 0

Figure C-11b Clutter Patch Definition Dialogue - Land Clutter Types



Seed Source: RSS Generated

Random Seed: 1

Figure C-12 Earth Clutter Seed Subdialogue

C1.9 DISCRETE CLUTTER DEFINITION

This dialogue (Figure C-13) is used to specify fixed discrete scatterers on the Earth's surface. It is accessed from the "Discrete Clutter" icon in the FOV top-level dialogue.

Earth discrete clutter elements are designed to simulate radar backscatter from specular targets, specifically buildings, that are in the SBR field of view. The discrete clutter elements are modelled as scatterers with a log-normal amplitude distribution. The mean and standard deviation are derived from user-entered median and peak values. Several default building types are provided with reset probability density function parameters.

Discrete Clutter ID identifies the discrete clutter element. The default names start with "DISCRETE-01" and count upward (-02, -03, ...) for each discrete added. This name can be changed to any name that doesn't conflict (match) any other object defined.

Latitude/Longitude are used to specify the geographic coordinates of a discrete clutter element. A discrete clutter element can be located anywhere on the Earth's surface, however, it should be positioned in the main beam to produce significant contributions to the radar signal.

Clutter Type provides default choices of RGS median, peak and spectral width for use in defining the random distribution. Three discrete types are provided with the following default distributions:

Table C-1 Discrete Clutter Distribution Presets

Clutter Type	RCS Median (dBsm)	RCS Peak (dBsm)	Spectral Width (kts)
Building	40	41	0.0
Mobile Home	42	46	0.0
Barn	40	45	0.0

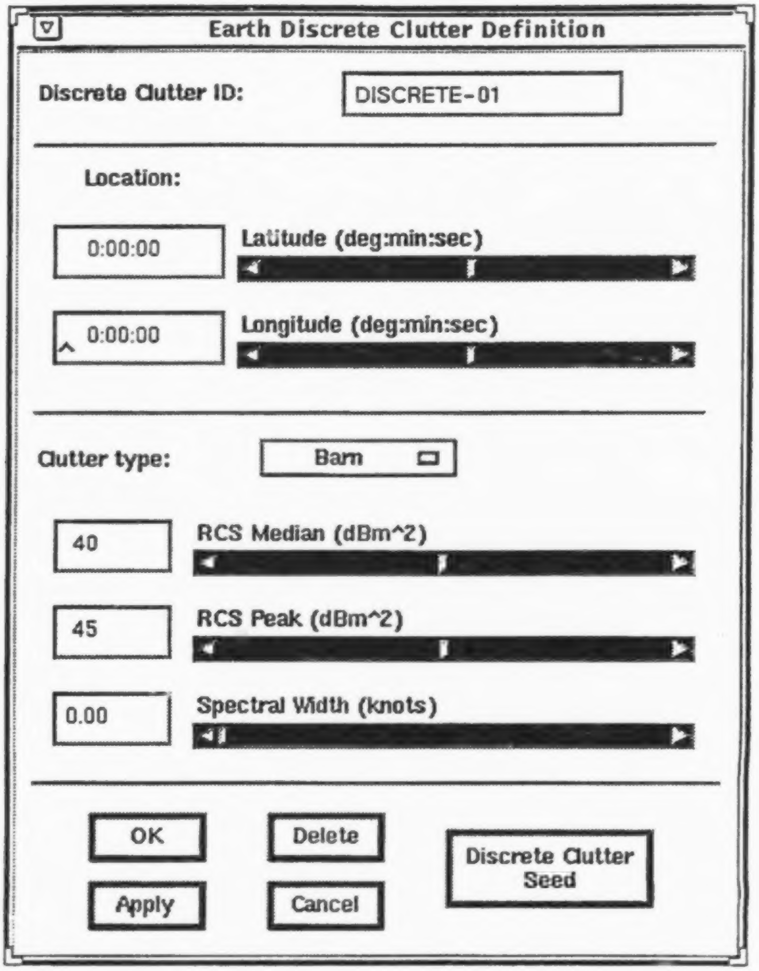
Other than defining these preset values for the random variation of the discrete target, the selection of Clutter Type has no other influence on the random process.

RCS Median specifies the median RCS of the discrete clutter element in the range 20 to 60 dBm^2. The default is set according to the Clutter type but can be changed by the operator.

RCS Peak specifies the peak RCS of the discrete clutter element in the range 20 to 70 dBm^2. Default values are set in the same way as RCS Median.

Spectral Width specifies the spectral width of the discrete clutter element in terms of an equivalent Doppler velocity in the range 0 to 1 knots. A non-zero spectral width may be used to model motion of a land-based target due to wind, or motion due to wave action if the discrete is placed on sea clutter to represent a vessel at sea.

Discrete Clutter Seed is used to access the discrete clutter seed subdialogue.



Earth Discrete Clutter Definition

Discrete Clutter ID: DISCRETE-01

Location:

Latitude (deg:min:sec): 0:00:00

Longitude (deg:min:sec): 0:00:00

Clutter type: Barn

RCS Median (dBm^2): 40

RCS Peak (dBm^2): 45

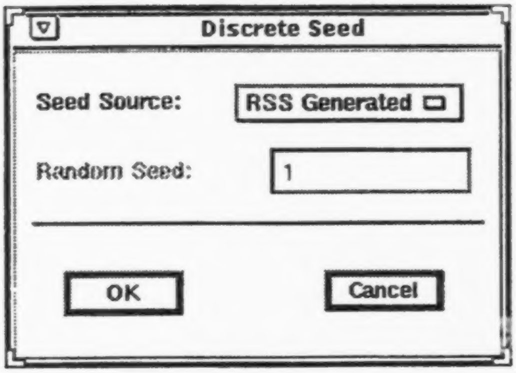
Spectral Width (knots): 0.00

Figure C-13 Earth Discrete Clutter Dialogue Definition

C1.9.1 Discrete Clutter Seed Subdialogue

This subdialogue (Figure C-14) is used to specify a random seed value for the random process used in the modelling of each discrete clutter object. It is accessed from the Discrete Clutter Definition dialogue by selecting "Discrete Clutter Seed".

Selecting "RSS Generated" will use a preset constant seed value providing exact repeatability of random process used to model this discrete. "User-Specified" allows selection of different values for statistically different runs.



Seed Source: RSS Generated

Random Seed: 1

Figure C-14 Discrete Clutter Seed Subdialogue

C1.10 TARGET DEFINITION

This dialogue (Figure C-15) is used to define discrete moving targets in the radar environment. It is accessed from the FOV Display dialogue by selecting "Targets"; an existing target can also be edited by clicking on a target in the FOV Display object list. This dialogue allows targets to be added, edited or deleted.

Targets in the SBR environment are modelled as discrete reflectors moving on great circle paths with specified altitude, heading and speed. The initial position is entered in latitude/longitude for the start of the simulated time interval, and the model computes subsequent target position from its speed and heading, assuming straight and level flight.

Target ID identifies the target. Default names start with "TARGET-01" and count upward. This name can be changed to any other name that doesn't conflict with any other object defined.

Latitude/Longitude are used to specify the initial geographic coordinates, or target nadir, if airborne, of a target. A target may be placed anywhere about the Earth, however, should be in the main beam to produce detectable signal levels.

Heading specifies the target heading (True, relative to North) in the range 0 to 360.0 degrees. Default is 0.0 degrees.

Altitude specifies the altitude of the target above the Earth's surface in the range 0 to 20,000 metres. Default is 10,000 m.

Speed specifies target speed along the specified heading vector in the range 0 to 2000 knots. A default value of 500 kt is provided.

Spectral Width specifies the spectral width of the target in terms of an equivalent Doppler velocity in the range of 0 to 4 knots. A non-zero value is used to model internal target motion (scintillation).

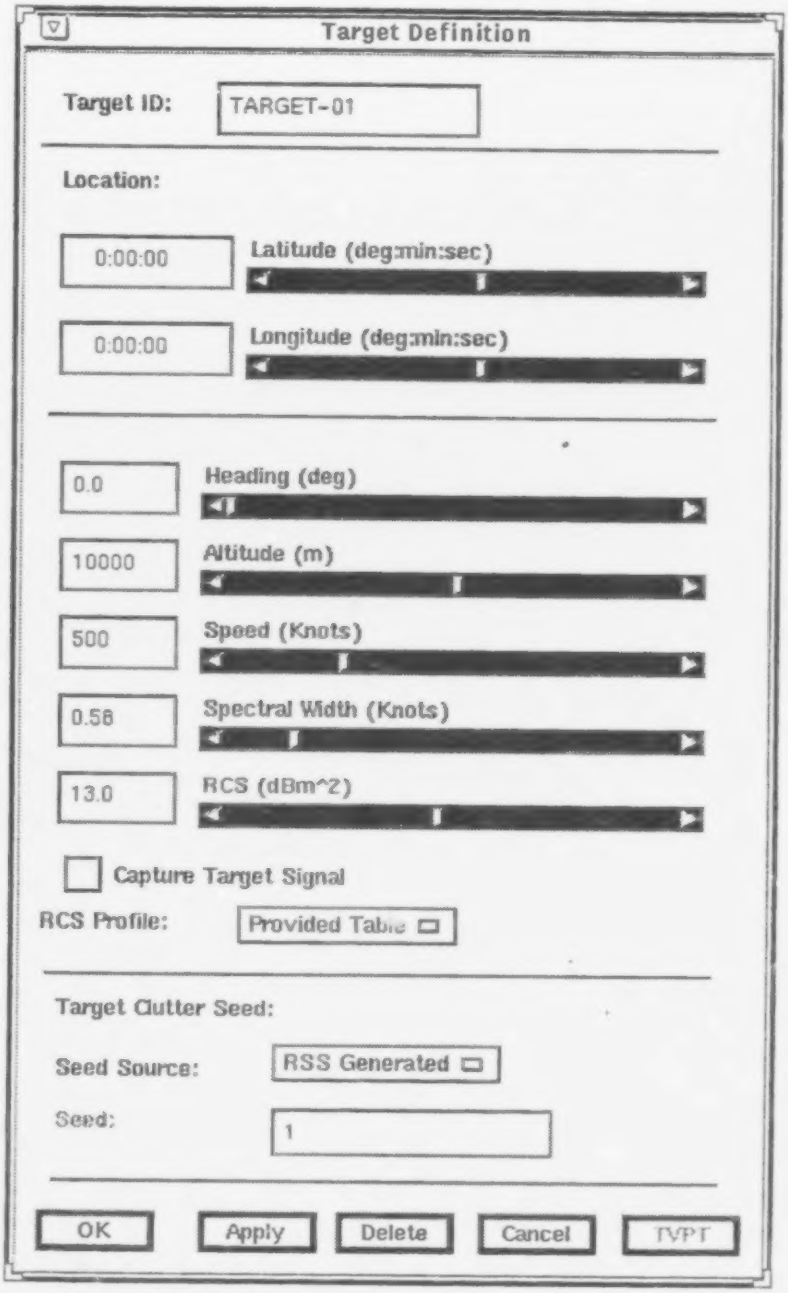
RCS specifies the mean target RCS in the range -10 to 40 dBm^2. A default value of 13 dBm^2 (target RCS of 20 m^2).

Capture Target Signal is used to enable capture of the signal representing this particular target during signal generation, before the composite radar signal is formed. In order to capture a target, this flag button must be enabled (indicated a "filled" or dark box), and the "Targets" signal data must be enabled in the RSS Data Capture Options dialogue (see A2.19).

RCS Profile provides two choices of a target RCS profile in azimuth and elevation. Choosing "Provided Table" selects a pre-defined profile in the signal generation process, while "Stored File" enables use of a user-defined file.

Target Clutter Seed: Similar to other random process seeds, "RSS Generated" selects a preset constant seed providing exact repeatability of the random process for this target. "User-Specified" allows selection of different seeds for statistically different runs.

At the bottom of the dialogue are the usual four utility buttons to accept changes and close the dialogue ("OK"), accept the changes and keep dialogue up ("Apply"), Cancel changes, and delete this target definition. The "TVPT" button provides direct access to the Time Varying Parameters Table, described in Section C1.2. This button is only enabled after loading the related Satellite/Radar definition.


Target Definition
Location:
Target Clutter Seed:
OK
Apply
Delete
Cancel
TVPT

Target ID: TARGET-01

Latitude (deg:min:sec): 0:00:00

Longitude (deg:min:sec): 0:00:00

Heading (deg): 0.0

Altitude (m): 10000

Speed (Knots): 500

Spectral Width (Knots): 0.56

RCS (dBm^2): 13.0

☐ Capture Target Signal

RCS Profile: Provided Table

Seed Source: RSS Generated

Seed: 1

Figure C-15 Target Definition Dialogue

C1.11 JAMMER DEFINITION

This dialogue (Figure C-16 to C-19) is used to specify jammers in the radar environment. It is accessed from the FOV Display dialogue by selecting "Jammers"; an existing jammer object can also be edited by selecting and clicking on a jammer in the FOV Display object list. This dialogue allows jammers to be added, edited or deleted. The following parameters are common to all the jammer dialogues.

Jammer ID identifies the jammer. Default names start with "JAMMER-01" and count upward. This name can be changed to any other name that does not conflict with any previously defined object.

Latitude/Longitude specifies the initial geographic coordinates of a jammer, or jammer nadir if airborne. A jammer may be placed anywhere about the Earth, except at the poles. To be effective, the jammer should be in the radar FOV for the particular geometry, but the main beam footprint should be avoided.

Heading specifies the jammer heading (True, relative to North), in the range 0 to 360 degrees (default 0.0 degrees).

Altitude specifies the jammer altitude in the range 0 to 20,000 metres (default zero-jammer at the surface).

Speed specifies the jammer speed in the range 0 to 500 kts. (default is zero - stationary jammer).

Capture Jammer is used to enable capture of the signal for this particular jammer during signal generation before the composite signal is formed. In order to capture a jammer, "Yes" must be selected in this dialogue, and the "Jammers" signal data must be enabled in the RSS Data Capture Options dialogue (see B1.19).

Seed Source is similar to other random process seeds, there is a random seed required for each jammer generated. "RSS Generated" selects a preset constant seed providing exact repeatability of the random process for this jammer. "User-Specified" allows selection of different seeds for statistically different runs.

Jammer Type is used to select the jammer type from the choices of:

- Barrage
- Follower
- Swept
- Deception

The choice alters the remaining parameters entered by the user, as described below in Subsections C1.11.1 to C1.11.4.

Start Time is used to specify the start time for jamming in a CTI. It can be used to start jamming mid-way through a dwell. The start time is specified in terms of the starting dwell, NCI and CPI, and additionally with an offset in milliseconds (range: 0 to 1000 ms). The values in the main dialogue are display only. To select or change the start time, click on "Start Time" to open a "Time Edit" subdialogue box, and adjust the parameters as desired. Note that validation is not done to ensure the specified DI, NCI, and CPI exist at this point - any out of range choice will cause warnings when signal generation is started.

Stop Time is used to specify the stop time for jamming in a CTI. It can be used to turn off jamming before the end of the CTI. The Stop Time is selected and edited in the same way as the Start Time.

Effective Radiated Power or ERP of the jammer is specified in the range 50 to 120 dBW (default 100 dBW).

Utility Buttons: "OK", "Apply", and "Cancel" are used in the jammer dialogues in their usual context (see Appendix A). "Delete" is used to delete a jammer, and "TVPT" accesses the Project/Extrapolate dialogue (time-varying parameter table) for this jammer. This is only enabled after loading a related Satellite/Radar definition.

C1.11.1 Barrage Jammer

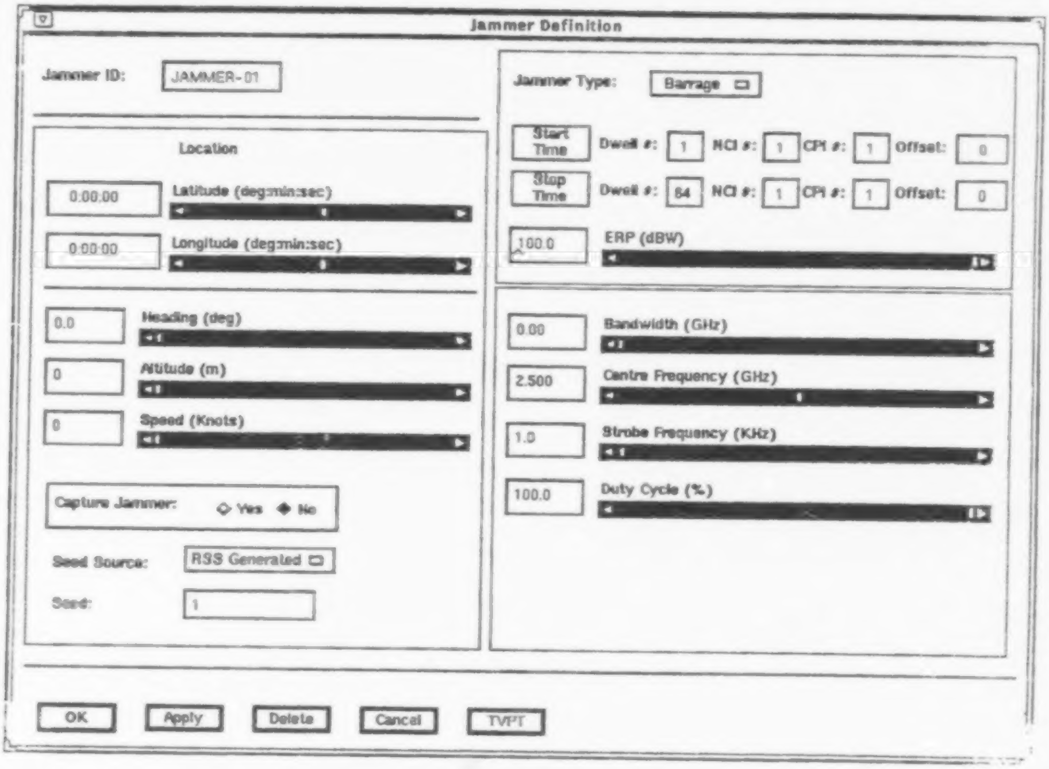
A barrage jammer simulates broadband noise jamming across a specified RF band. Barrage jammers may be continuous or pulsed. If a barrage jammer type is selected, the following parameters are specified (also see Figure C-16).

Bandwidth specifies the bandwidth of the noise emitted by the jammer over the range 0.0 to 2.0 GHz. Noise power is modelled as flat across this bandwidth. The default of zero is provided. This should be set to a non-zero value.

Centre Frequency specifies the centre frequency of the jammer in the range 1.0 to 4.0 GHz (default 2.5 GHz). To be effective, the jammer bandwidth should overlap some or all of the receiver bandwidth.

Strobe Frequency specifies jammer strobing rate, and is effective if a duty cycle of less than 100% is selected. Range of values: 0 to 100 kHz (default: 1 kHz).

Duty Cycle specifies the "on" duty cycle of the jammer, over the range 0 to 100% (default 100%). A value less than 100% produces pulsed jamming at the strobing rate specified above.



Jammer ID: JAMMER-01

Latitude (deg:min:sec): 0:00:00

Longitude (deg:min:sec): 0:00:00

Heading (deg): 0.0

Altitude (m): 0

Speed (Knots): 0

Capture Jammer: ◇ Yes ◆ No

Seed Source: RSS Generated

Seed: 1

Jammer Type: Barrage

Start Time: Dwell #: 1 NCI #: 1 CPI #: 1 Offset: 0

Stop Time: Dwell #: 64 NCI #: 1 CPI #: 1 Offset: 0

ERP (dBW): 100.0

Bandwidth (GHz): 0.00

Centre Frequency (GHz): 2.500

Strobe Frequency (KHz): 1.0

Duty Cycle (%): 100.0

Figure C-16 Jammer Definition Dialogue - Barrage Type

C1.11.2 Swept Jammer

The swept jammer is similar to the barrage jammer, but the noise bandwidth is smaller and is swept linearly across a broader band. If a swept type jammer is selected, the following are specified (also see Figure C-17):

Mid-Sweep Frequency specifies the mid-point of frequencies swept by the jammer in the range 1.0 to 4.0 GHz (default 2.5 GHz).

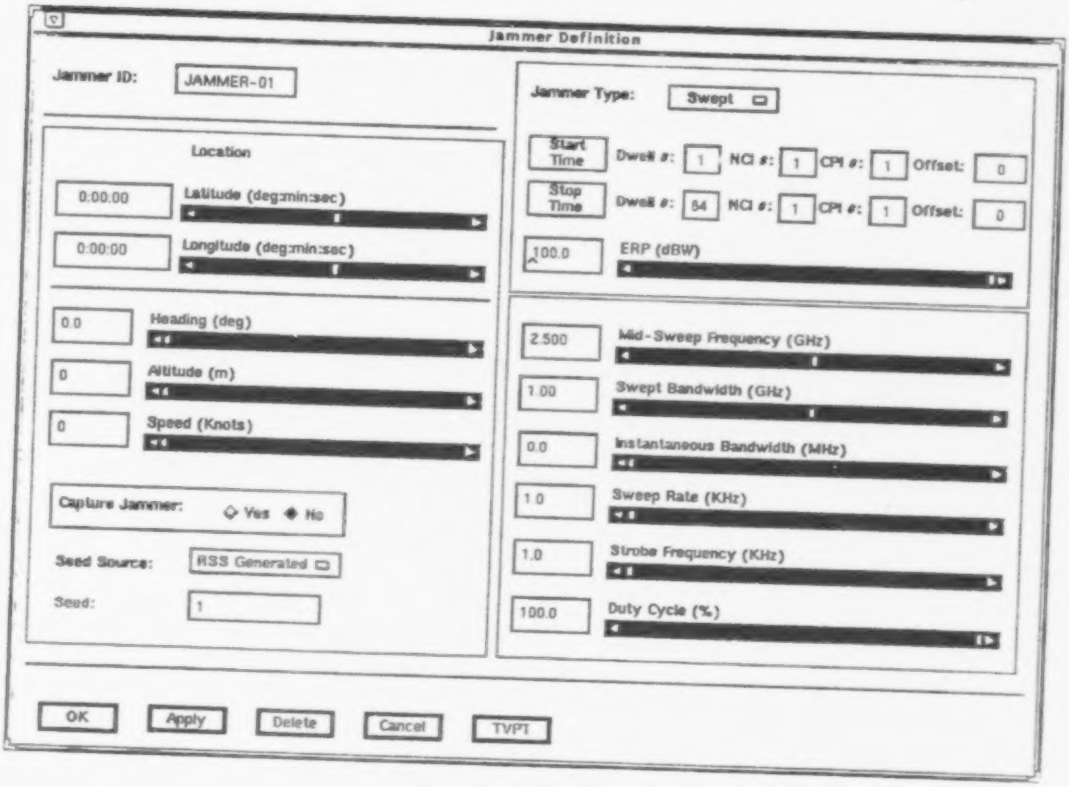
Swept Bandwidth specifies the total bandwidth swept by the jammer in the range 0.0 to 2.0 GHz (default 1.0 GHz).

Instantaneous Bandwidth specifies the instantaneous bandwidth of the jammer in the range 0.0 to 10.0 MHz. The default value of zero should be adjusted to the desired non-zero bandwidth.

Sweep Rate specifies the sweep rate of the jammer in the range 0 to 100 kHz (default 1.0 kHz).

Strobe Frequency specifies on/off strobing of the jammer. See Barrage type jammer. Same range and default.

Duty Cycle: see Barrage type jammer. Same range and default.



Jammer ID: JAMMER-01
Latitude (deg:min:sec): 0:00:00
Longitude (deg:min:sec): 0:00:00
Heading (deg): 0.0
Altitude (m): 0
Speed (Knots): 0
Capture Jammer: ○ Yes ● No
Seed Source: RSS Generated
Seed: 1

Jammer Type: Swept
Start Time: Dwell #: 1 NCI #: 1 CPI #: 1 Offset: 0
Stop Time: Dwell #: 64 NCI #: 1 CPI #: 1 Offset: 0
ERP (dBW): 100.0
Mid-Sweep Frequency (GHz): 2.500
Swept Bandwidth (GHz): 1.00
Instantaneous Bandwidth (MHz): 0.0
Sweep Rate (KHz): 1.0
Strobe Frequency (KHz): 1.0
Duty Cycle (%): 100.0

Figure C-17 Jammer Definition Dialogue - Swept Type

C1.11.3 Follower Jammer

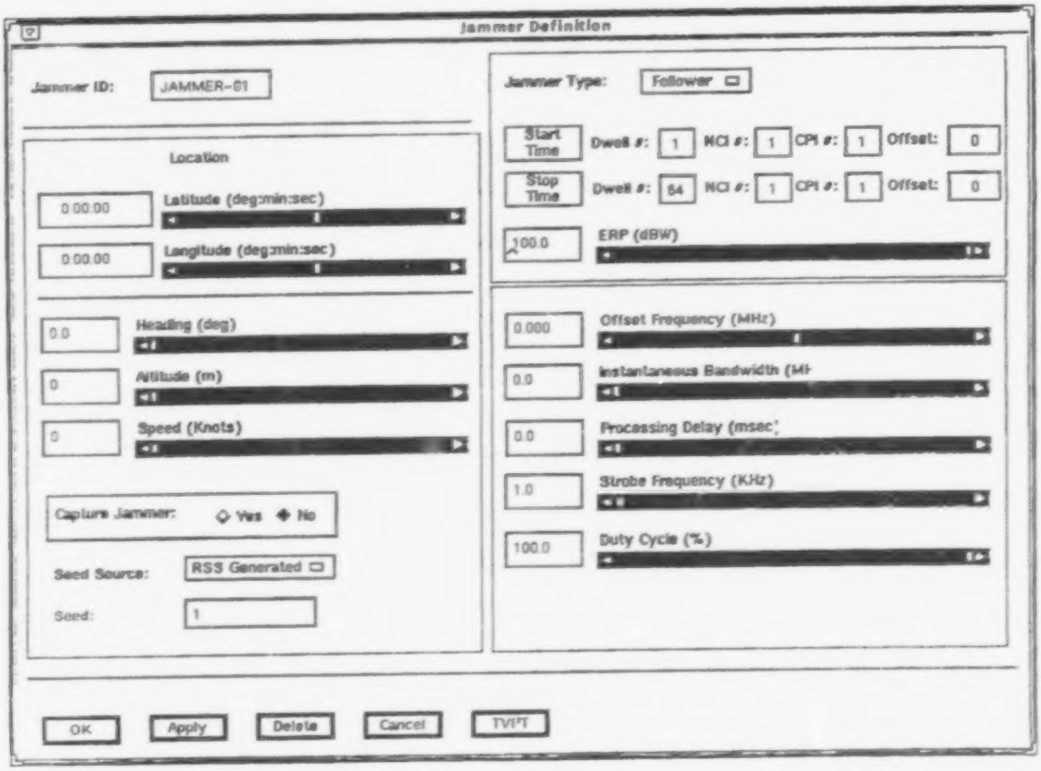
The follower jammer is similar to the swept jammer, however, it measures the SBR transmit frequency and tracks it, attempting to maximize the jammer energy in the passband of each burst. For the follower jammer, the following is specified (see Figure C-18).

Offset Frequency is the offset frequency from the jammer band centre to SBR band centre, specified in the range -5.0 to +5.0 MHz (default 0.0 MHz).

Instantaneous Bandwidth is same as swept jammer.

Processing Delay specifies the processing delay of the jammer in estimating the SBR carrier frequency, excluding SBR to jammer propagation delay. Range: 0 to 10 ms (default 0 ms).

Strobe Frequency and Duty Cycle specify a pulsed follower jammer and are specified same as the barrage and swept types.



Jammer ID: JAMMER-01
Latitude (deg:min:sec): 0:00:00
Longitude (deg:min:sec): 0:00:00
Heading (deg): 0.0
Altitude (m): 0
Speed (Knots): 0
Capture Jammer: ○ Yes ● No
Seed Source: RSS Generated
Seed: 1
Jammer Type: Follower
Start Time Dwell #: 1 NCI #: 1 CPI #: 1 Offset: 0
Stop Time Dwell #: 64 NCI #: 1 CPI #: 1 Offset: 0
ERP (dBW): 100.0
Offset Frequency (MHz): 0.000
Instantaneous Bandwidth (MH: 0.0
Processing Delay (msec): 0.0
Strobe Frequency (KHz): 1.0
Duty Cycle (%): 100.0

Figure C-18 Jammer Definition Dialogue - Follower Type

C1.11.4 Deception Jammer

The deception or false target jammer is the most sophisticated of the four types modelled. The deception jammer receives a sample of the SBR waveform, then processes and retransmits replicas with false range and Doppler shifts simulating real targets. If a deception type jammer is selected, the following is user entered (also see Figure C-19).

Number of False Targets specifies the number of false target replicas generated, in the range of 1 (minimum) to 100 (maximum). The value is edited directly, and if changed, will update list of false targets.

Deception Method specifies the algorithm used in false target generation. Two choices are provided:

1) Time Shifted; and
2) Phase Modulated.

Default is Time Shifted.

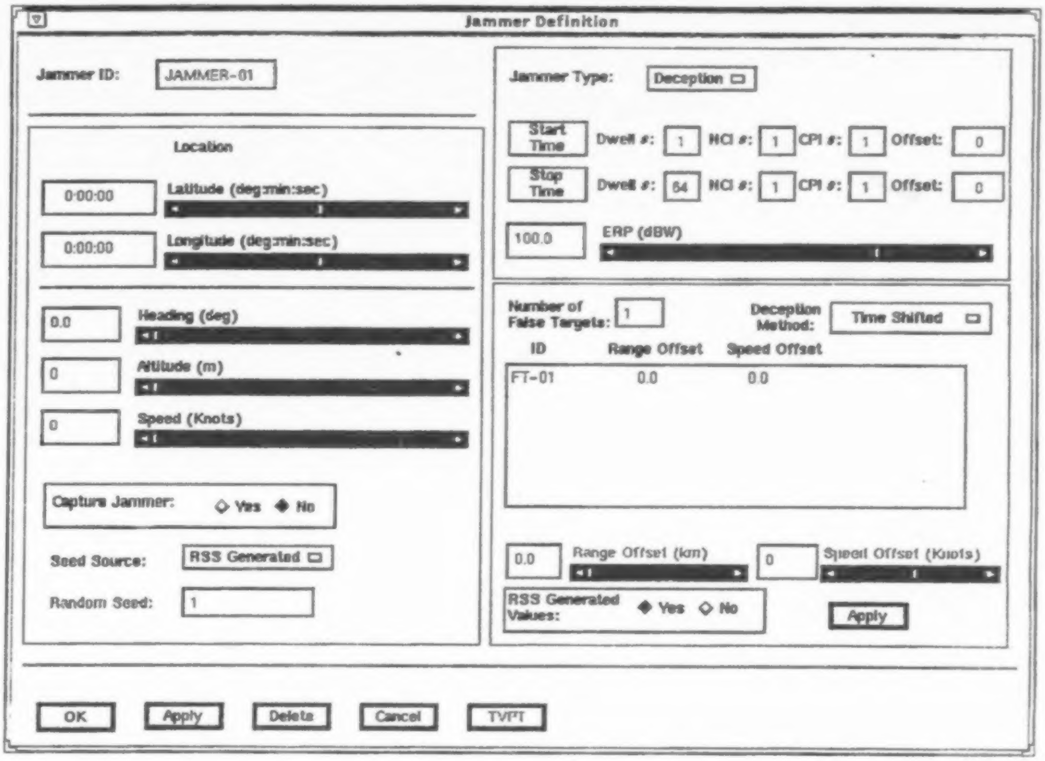
RSS Generated Values specifies whether the RSS computes the false target range and speed offsets. This is used to avoid manually entering all offsets if a large number of false targets are desired. If "Yes" is selected, then the range and speed offsets will be computed to give a nominal spread of false targets. Manual entry of Range Offset and Speed Offset is disabled. If "No" is selected, then the range and speed offsets must be entered for each false target.

Note: In Version 4.1 (November 1994) of the software, RSS generated values are not available.

False Target List is a rectangular box area identifying each false target (FT-01, FT-02, etc.), and the range and speed offset of each false target generated by the deception jammer. A vertical scroll bar is provided if the number of false targets exceeds the size of the display area. To manually alter the range and speed offset of a false target, first ensure RSS Generated Value is "off", and then select the false target by clicking on it. Note that if RSS Generated offsets are enabled ("Yes" selected) then these displayed values are not used and should be ignored.

Range Offset specifies the range offset of a false target relative to the actual range of the deception jammer. Valid range is 0 to 150 km (default zero). First click on the desired false target to select it, and then use the slider bar to adjust the value. Press "Apply" to update the false target with the new values.

Speed Offset specifies the speed offset of a false target relative to the actual speed of the deception jammer. Valid range is -2000 knots to 2000 knots (default zero).



Jammer ID: JAMMER-01

Latitude (deg:min:sec): 0:00:00

Longitude (deg:min:sec): 0:00:00

Heading (deg): 0.0

Altitude (m): 0

Speed (Knots): 0

Capture Jammer: ◇ Yes ◆ No

Seed Source: RSS Generated

Random Seed: 1

Jammer Type: Deception

Start Time Dwell #: 1 HCI #: 1 CPI #: 1 Offset: 0

Stop Time Dwell #: 64 HCI #: 1 CPI #: 1 Offset: 0

ERP (dBW): 100.0

Number of False Targets: 1

Deception Method: Time Shifted

ID	Range Offset	Speed Offset
FT-01	0.0	0.0

Range Offset (km): 0.0

Speed Offset (Knots): 0

RSS Generated Values: ◆ Yes ◇ No

Apply

Figure C-19 Jammer Definition Dialogue - Deception Type

C1.12 CHAFF BUNDLE DEFINITION

This dialogue (Figure C-20) is used to specify parameters for the modelling of chaff bundles in the radar environment. It is accessed from the FOV Display dialogue by selection of "Chaff Bundle"; an existing chaff bundle definition may also be edited by selecting and clicking on a chaff bundle object in the FOV Display object list.

Chaff is modelled in terms of its steady-state characteristics after deployment. This neglects aerodynamic effects and models the chaff cloud in terms of the amplitude statistics, Doppler shift and temporal correlation. For details on chaff modelling, see Appendix J.7 "Precipitation and Chaff Computations", Testbed Preliminary Design (R-13).

Note: In SPD Version 4.1 (November 1994), the chaff models are not implemented.

Chaff Bundle ID identifies the chaff bundle. Default names start with "CHAFF-01" and count upward "-02", "-03", etc. This name can be changed to any other name that does not conflict with any previously defined object.

Latitude/Longitude specifies the initial geographic position of the chaff bundle (default is 0°N/0°E). A chaff bundle may be modelled anywhere about the Earth except at the poles. To be effective, chaff should be in or near the main beam footprint.

Altitude specifies the initial altitude of chaff in the range 0 to 20,000 m (default 5000 m).

Weight specifies the mass of the chaff bundle in the range 0 to 5.0 kg (default 0.5 kg).

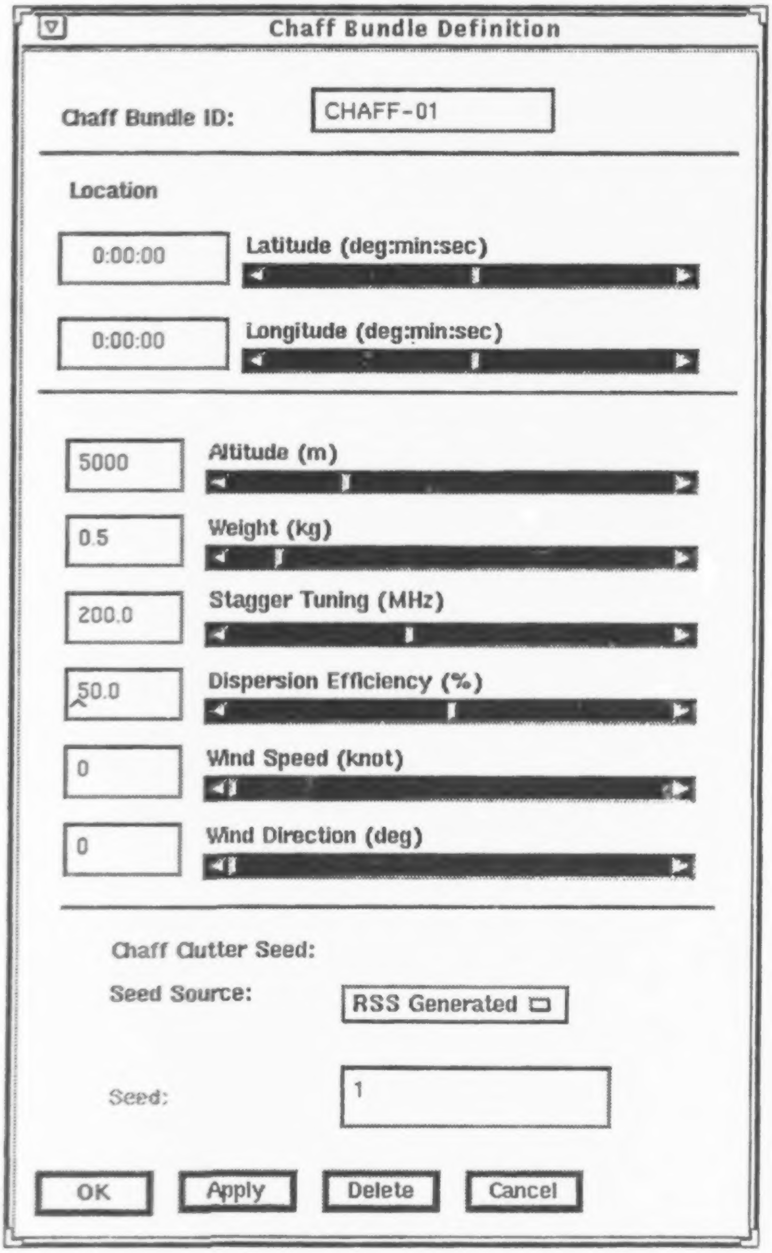
Stagger Tuning specifies the stagger tuning of dipoles in the chaff bundle in the range 1 to 500 MHz (default 200 MHz).

Dispersion Efficiency specifies the fraction of the total weight that will produce an effective RCS at the frequency of concern. Range of values: 0 to 100% (default 50%).

Wind Speed specifies the prevailing wind speed in the range 0 to 100 knots (default zero). This affects the Doppler shift and spectral spread of chaff backscatter.

Wind Direction specifies the prevailing wind direction in the range 0 to 360 degrees true (default 0.0 degrees).

Chaff Clutter Seed is similar to other random processes, a random speed is required for each chaff bundle modelled. "RSS Generated" selects a preset seed value providing exact repeatability of the chaff random process; "User Specified" allows selection of different speed values for statistically different runs.


Chaff Bundle Definition
OK
Apply
Delete
Cancel

Chaff Bundle ID: CHAFF-01

Location

Latitude (deg:min:sec): 0:00:00
Longitude (deg:min:sec): 0:00:00

Altitude (m): 5000
Weight (kg): 0.5
Stagger Tuning (MHz): 200.0
Dispersion Efficiency (%): 50.0
Wind Speed (knot): 0
Wind Direction (deg): 0

Chaff Clutter Seed:
Seed Source: RSS Generated
Seed: 1

Figure C-20 Chaff Bundle Definition Dialogue

APPENDIX D

SIMULATION RUN DEFINITION HMI

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APPENDIX D

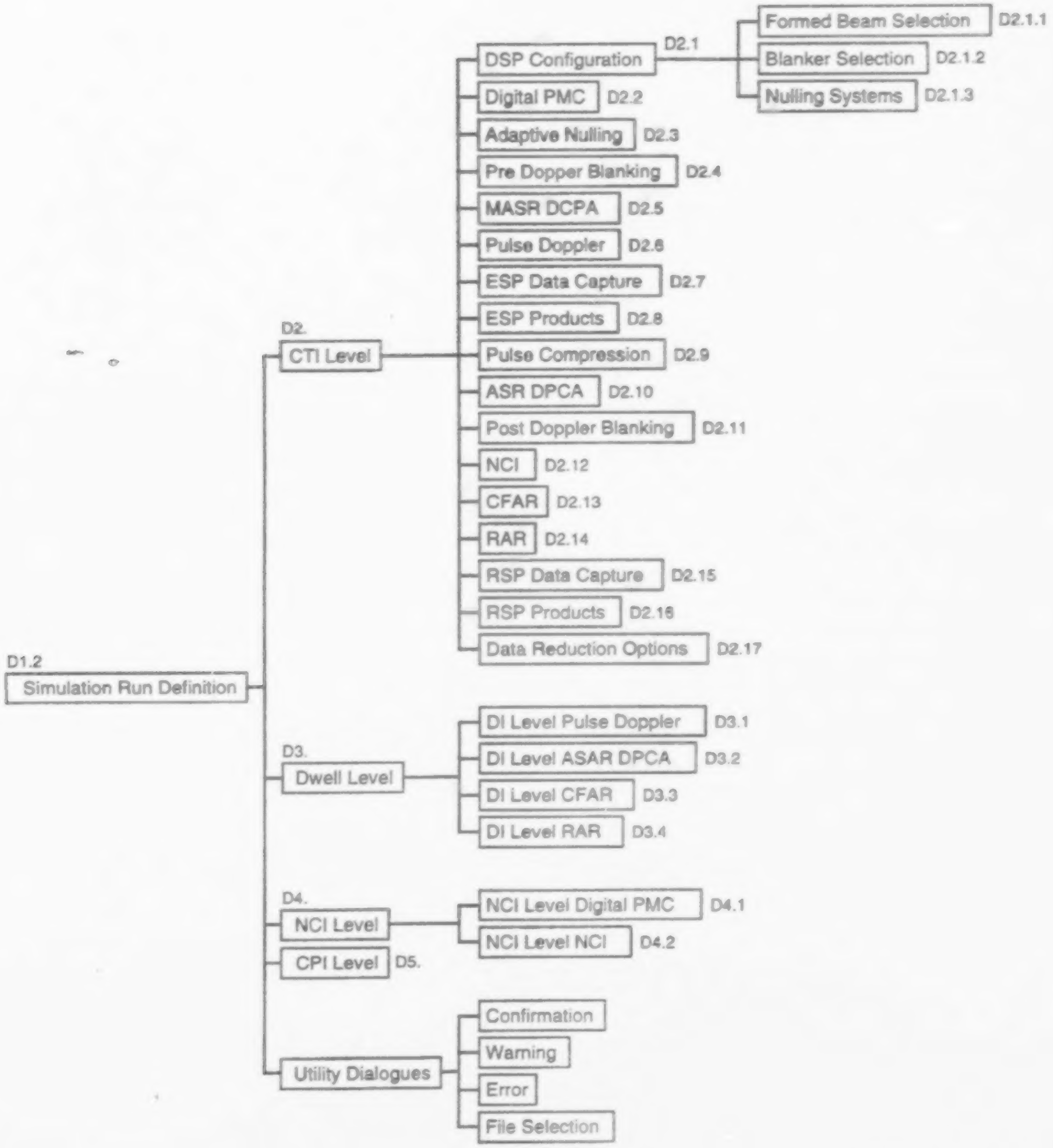
SIMULATION RUN DEFINITION HMI

D1. SIMULATION RUN DEFINITION HMI

The SPD Simulation Run HMI is used to define the "run time" parameters for the playback and processing of simulated radar signal data by the DSP. A "Simulation Run Definition" is created after the radar data has been generated. The Run definition allows the user to create or retrieve definitions and edit parameters that control the playback and signal processing. Numerous processing parameters allow many kinds of experiments to be conducted to compare performance. The Simulation Run parameters are stored in files with the default file extension of *.sim_def*, and then may be selected in the Monitor/Control Simulation Run HMI.

D1.1 Dialogue Hierarchy Diagram

The Simulation Run HMI is implemented using a hierarchy of dialogue boxes as illustrated in Figure D-1. Each dialogue box represents a grouping of related parameters by function and by changeability over the duration of the waveform.


D1.2
Simulation Run Definition
D2.
CTI Level
DSP Configuration
D2.1
Formed Beam Selection
D2.1.1
Blanker Selection
D2.1.2
Nulling Systems
D2.1.3
Digital PMC
D2.2
Adaptive Nulling
D2.3
Pre Dopper Blanking
D2.4
MASR DCPA
D2.5
Pulse Doppler
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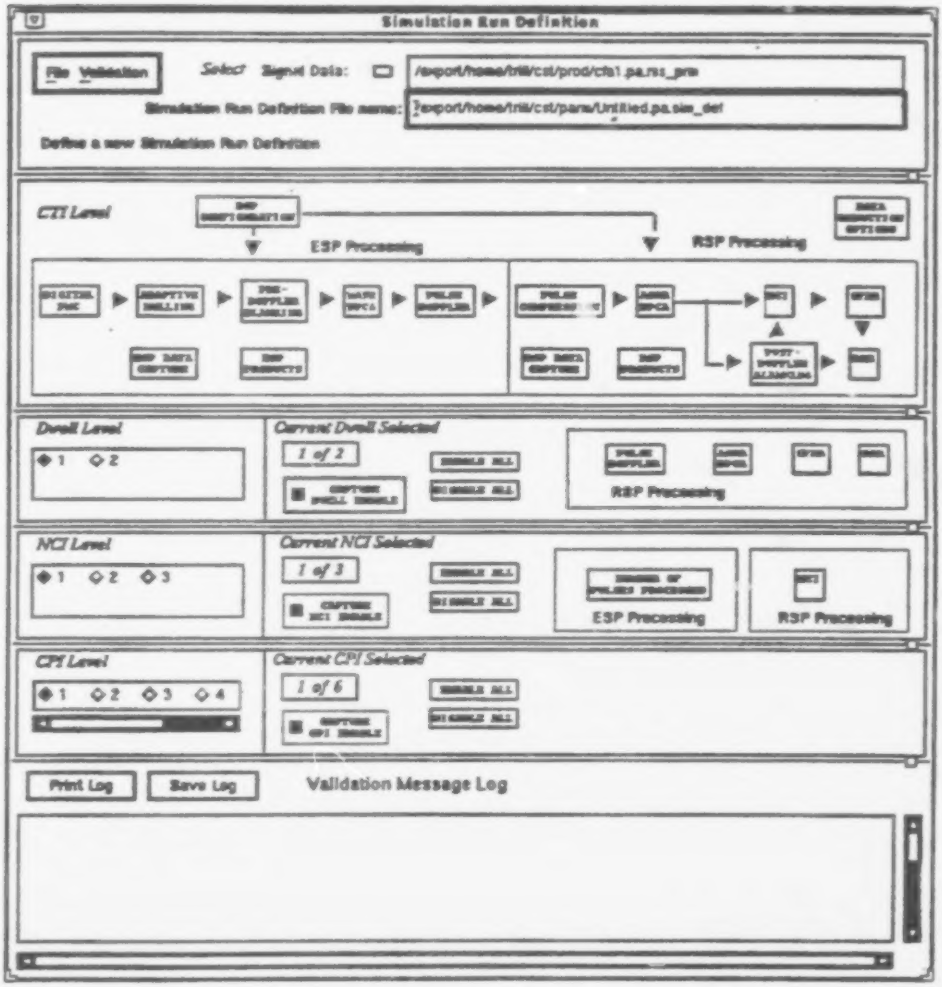
D2.10
Post Doppler Blanking
D2.11
NCI
D2.12
CFAR
D2.13
RAR
D2.14
RSP Data Capture
D2.15
RSP Products
D2.16
Data Reduction Options
D2.17
D3.
Dwell Level
DI Level Pulse Doppler
D3.1
DI Level ASAR DPCA
D3.2
DI Level CFAR
D3.3
DI Level RAR
D3.4
D4.
NCI Level
NCI Level Digital PMC
D4.1
NCI Level NCI
D4.2
CPI Level
D5.
Utility Dialogues
Confirmation
Warning
Error
File Selection

Figure D-1 Simulation Run Definition Dialogue Hierarchy

D1.2 Top Level Dialogue

The top-level dialogue, titled Simulation Run Definition (Figure D-2), is the initial dialogue presented when this HMI is activated. It is activated by clicking on its start-up icon or by typing the command *rundef* at the Unix prompt.



Signal Data: /export/home/trill/cst/prod/cfa1.pa.rss_pre

Simulation Run Definition File name: /export/home/trill/cst/para/Untitled.pa.sim_def

Define a new Simulation Run Definition

Current Dwell Selected: 1 of 2

Current NCI Selected: 1 of 3

Current CPI Selected: 1 of 6

Simulation Run Definition
File Validation
Select
CTI Level
ESP Processing
RSP Processing
Dwell Level
◆ 1 ◇ 2
RSP Processing
NCI Level
◆ 1 ◇ 2 ◇ 3
ESP Processing
RSP Processing
CPI Level
◆ 1 ◇ 2 ◇ 3 ◇ 4
Print Log
Save Log
Validation Message Log

Figure D-2 Simulation Run Definition Top-Level Dialogue

The top-level Simulation Run dialogue is organized similar to the Satellite/Radar Definition HMI. It is designed as a "visualization" window, providing both a functional and temporal representation of processing parameters, and provides access to the lower level dialogues which contain simulation run parameters.

The top-level dialogue has the following main areas:

- pull-down menu bar items: File and Validation;
- text field display of Signal Data Filename and Simulation Run Definition Run Definition Filename;
- CTI (or Run) level definition area;
- Dwell level definition area;
- NCI level definition area;
- CPI level definition area;
- Validation message area.

Each area is designed as a paned window; the size of which can be adjusted by dragging the sash up or down. The sash is the small box at the bottom right of each area. The overall window size may also be manipulated by dragging the corners of the window.

D1.3 Functional Associations

The Simulation Run top-level dialogue groups parameters together according to the functions and stages in the signal processor. The full signal processing chain in the ESP and RSP is represented at the CTI level by icons starting with digital platform motion compensation, and progressing through nulling, blanking, MASR DPLA and pulse Doppler processing in the ESP, and continuing with RSP functions for pulse compression, ASAR DPCA, range-Doppler blanking, NCI and detection. Clicking on any of these icons opens the corresponding dialogue box for display or editing of parameters.

D1.4 Temporal Associations

Similar to the Satellite/Radar definition, the temporal associations are depicted by the grouping of icons in CTI, dwell, NCI and CPI levels. The current interval in each level is indicated by "Current Dwell/NCI/CPI Selected". The diamond-shaped radio buttons are used to select one interval at a time.

The corresponding functional parameters that are changeable at each level are depicted by icons. At the dwell level, parameters are changeable in pulse Doppler, ASAR DPCA, CFAR and RAR. At the NCI level, the number of pulses are processed and selected.

Integration parameters are changeable. At the CPI level there are no changeable processing parameters, however, data capture for individual CPIs is selectable.

In the Simulation Run HMI, the temporal organization (i.e., number of dwells, NCIs CPIs) is determined by the associated Satellite/Radar definition referred by the selected Signal Data file. Since this structure is fixed for a given signal, the "Create", "Copy" and "Delete" interval functions are not provided.

D1.5 Menu Bar Functions

The following pull-down functions are provided:

File		
	New	Initialize a new in-memory Simulation Run definition. The HMI will prompt for the name of the Signal Data file to use to initialize Satellite and waveform dependent parameters. The definition filename defaults to "Untitled.pa.sim_def".
	Open	Open an existing Simulation Run Definition file. A file selection dialogue appears for selecting the desired file.
	Save	Save the in-memory structure to the currently named Simulation Run definition filename.
	Save As	Save the in-memory structure to a newly named file. A file selection dialogue appears for entering a new filename.
	Exit	Exit from the Simulation Run HMI; prompt the user with a confirmation dialogue; if changes have been made but not saved, a prompt will appear asking whether to save changes before exiting.
Validation→Start		This performs validation of the simulation run definition, checking for any inconsistent or out of range values. Messages are reported in the Validation Message Log area.

D1.6 Setting up a Simulation Run Definition

To set up a new simulation run definition after signal data has been generated, first activate *File→New* from the menu bar. This will open a file selection dialogue to prompt for a RSS processing parameter. Choose the desired RSS parameters file (default extension is *.pa.rss_prm*) and confirm with "OK". This file contains the RSS derived parameters, and pointers to the signal data and associated Satellite/Radar and Environment definition. The definition files are used to set up dependencies in the Simulation Run definition. These dependencies include:

- number of DPCA groups;
- number of Phase Centres per group;
- number of auxiliaries and delay taps;
- number of dwells, NCIs CPIs.

The Simulation Run filename initially defaults to *Untitled.pa.Sim_def.* Use *File→Save As* to enter the desired name of the file. Only the prefix is needed; the extension *.pa.sim_def* is automatically added.

If a previous Simulation Run Definition is to be edited and reused to process a signal data file, use *File→Open* to select and load the desired definition into in-memory data structures. The simulation run filename will be displayed in the top-level dialogue.

Once the in-memory structures are initiated, the Simulation Run parameters can be accessed and modified in any order. However, some dependencies do exist such as enabling pre-Doppler and range-Doppler blanking under "DSP Configuration" before the respective blanking icons are enabled. The suggested order of display and editing is from top to bottom. Begin with selection of the runtime DSP configuration in the CTI level, and then proceed stage by stage through the ESP and RSP processing icons on the CTI level. Select any desired data reduction options at the CTI level.

Then proceed to the dwell level, displaying or editing any processing parameters changeable at the DI level. Only some RSP parameters are changeable at this level. "Capture Dwell Enable" toggles on/of the capture of intermediate results at the DI level. The only product affected by this selection are pulse compression replicas, computed at each DI level. Note that enabling/disabling this button does not affect products captured at the NCI or CPI level.

For each dwell, choose each NCI in the dwell and edit the desired processing parameters in the ESP and RSP. "Capture NCI Enable" is used to toggle on/off the capture of Post-NCI data from the RSP.

Finally, for each CPI in each NCI, edit the "Capture CPI Enable" to select intervals in all other ESP and RSP intermediate results. The capturing of these products only depends on the setting at this level, and not the DI and NCI Enable buttons, described above. There are no other DSP processing parameters selectable at this level.

Once the Simulation Run definition is set to the desired values, run a validation (menu: *Validation→Start*) to check and review the definition. Edit and revalidate as necessary to get a satisfactory definition, and then save it to a named file.

D2. CTI LEVEL

D2.1 DSP Configuration

This dialogue (Figure D-3) is used to specify the DSP processing configuration for one run. It is accessed from the top-level dialogue by selecting DSP Configuration at the CTI level.

Satellite/Radar Definition Antenna Characteristics is a display-only area containing information extracted from the Satellite/Radar definition associated with the signal data file. "Concept" indicates the SBR concept selected: either CFA or RRA. "Number of DPCA Groups" indicates the number of groups: 1 or 2 for CFA; preset to 1 for RRA. "Number of Phase Centres per Group" indicates the number of phase centres in one group: 1, 2 or 3 for CFA; preset to 1 only for RRA. "Number of Main/Phase Centres Available" is the product of these, indicating the total number of main phase centres. "Number of Auxiliaries" indicates the total number of auxiliary and tap delay channels available in the signal.

DPCA Mode specifies the type of DPCA desired if CFA signals are being processed. Changing the DPCA mode will reset the formed beam selection and nulling systems to default values. The user is prompted before this operation is completed.

Monopulse enables monopulse processing if CFA signals are being processed. "Yes" enables monopulse processing and requires the user to define the formed beam selection. Changing the monopulse mode will also reset the nulling systems to default values.

Number of Range Doppler Blankers specifies the number of range Doppler blankers. The valid range depends on monopulse enable and the total number of auxiliaries defined according to the following logic:

	Range
Monopulse enabled:	0
ASAR DPCA/monopulse off:	0 to minimum of (1, number of auxiliaries)
Others:	0 to minimum of (2, number of auxiliaries)

Default is 0 Range-Doppler blankers.

Number of Pre-Doppler Blankers specifies the number of pre-Doppler blankers in the range 0 to the lesser of 4 or the number of auxiliaries (default 0). The number of pre-Doppler blankers must be greater than or equal to the number of range-Doppler blankers enabled.

Valid DSP Configurations

The following are valid DSP configurations that may be available, depending on the number of phase centres in the signal:

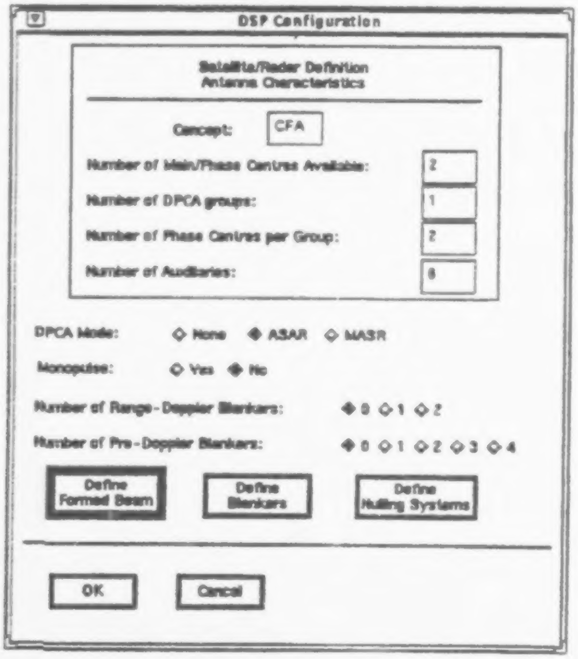
Table D-1 Valid DSP Configurations

DPCA Mode	Monopulse	No. RD Blankers	No. PD Blankers
None	No	0 - 2	0 - 4
	Yes	0	0 - 4
ASAR	No	0 - 1	0 - 4
	Yes	0	0 - 4
MASR	No	0 - 2	0 - 4
	Yes	0	0 - 4

Define Formed Beam provides access to the Formed Beam Selection subdialogue described in section D2.1.1.

Define Blankers provides access to the Blanker Selection Subdialogue described in section D2.1.2.

Define Nulling Systems provides access to the Nulling System Subdialogue described in section D2.1.3.


DSP Configuration
Satellite/Radar Definition
Antenna Characteristics
Define Formed Beam
Define Blankers
Define Nulling Systems
OK
Cancel

Concept: CFA

Number of Main/Phase Centres Available: 2

Number of DPCA groups: 1

Number of Phase Centres per Group: 2

Number of Auxiliaries: 8

DPCA Mode: ○ None ● ASAR ○ MASR

Monopulse: ○ Yes ● No

Number of Range-Doppler Blankers: ● 0 ○ 1 ○ 2

Number of Pre-Doppler Blankers: ● 0 ○ 1 ○ 2 ○ 3 ○ 4

Figure D-3 DSP Configuration Dialogue

D2.1.1 Formed Beam Selection

This dialogue provides selections of the phase centres to be processed into formed beams for one run. It is accessed from the DSP Configuration dialogue by selecting "Define Formed Beam".

The choices of formed beams depends on the following parameters:

Parameters	Set In
DPCA Mode	DSP Configuration
Monopulse Mode	DSP Configuration
Number of DPCA Groups	Satellite/Radar Definition
Number of Phase Centres per Group	Satellite/Radar Definition

Table D-2 lists all valid combinations of the above parameters, the number of formed beam choices, and an index to the figures illustrating the Formed Beam Selection. Figures D-4a to D-4x show all possible combinations (total of 24) of the Formed Beam Selection dialogue. Depending on the parameters above, one of these 24 dialogues is opened.

The titles use the following convention:

[DPCA_mode]_[Monopulse_enable]_m_n

where

DPCA_mode = None, ASAR, MASR
Monopulse_enable = Off, On
m = Number of DPCA groups
n = Number of Phase Centres per Group

Selecting a Formed Beam

The Formed Beam Selection dialogue indicates the choices of phase centre combinations in the form of a display-only button grid. A "filled" (or dark) button indicates that the corresponding phase centre is selected for the indicated formed beam, and "unfilled" (or light outline) button means a phase centre is not selected. The choice of formed beam is made by toggling the radio buttons across the top of the dialogue beside "Select". The choices are exclusive - only one combination of phase centres is selected at a time.

The left side identifies the phase centres of the dialogue. "Formed Beam 1" and "Formed Beam 2" areas show the phase centres selected for each formed beam. If monopulse is enabled, then phase centre choices will be displayed for both formed beams, otherwise choices only appear for Formed Beam 1. "Grp" indicates the DPCA group number (Group 1 or 2), and "PC" identifies the phase centre in a group as L: leading, M: middle, or T: trailing. "Chan ID" indicates the numeric channel identifier of the phase centre.

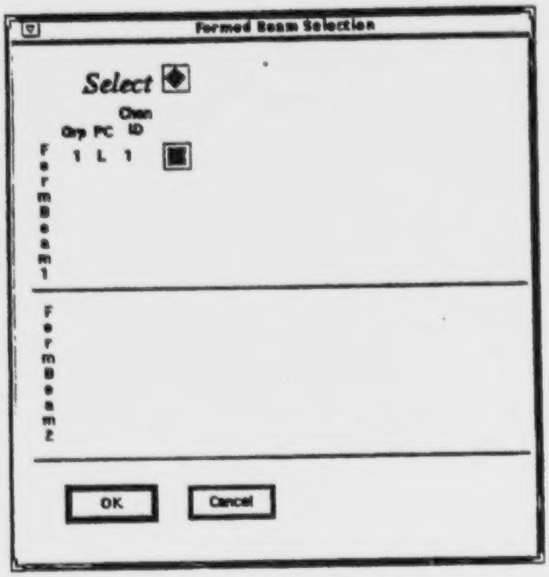
Table D-2 Formed Beam Selections

DPCA Mode	Number of Formed	Number of DPCA	Number of Phase	No. of Formed	Figure #	Title
None	1/No	1	1	1	D-4a	None_Off_1_1
		1	2	2	D-4b	None_Off_1_2
		1	3	3	D-4c	None_Off_1_3
		2	1	2	D-4d	None_Off_2_1
		2	2	4	D-4e	None_Off_2_2
		2	3	6	D-4f	None_Off_2_3
	2/Yes	1	2	1	D-4g	None_On_1_2
		1	3	3	D-4h	None_On_1_3
		2	1	1	D-4i	None_On-2_1
		2	2	6	D-4j	None_On_2_2
		2	3	15	D-4k	None_On_2_3
ASAR	1/No	1	2	1	D-4l	ASAR_Off_1_2
		1	3	3	D-4m	ASAR_Off_1_3
		2	2	2	D-4n	ASAR_Off_2_2
		2	3	6	D-4o	ASAR_Off_2_3
	2/Yes	1	3	1	D-4p	ASAR_On_1_3
		2	3	2	D-4q	ASAR_On_2_3
MASR	1/No	1	2	1	D-4r	MASR_Off_1_2
		1	3	4	D-4s	MASR_Off_1_3
		2	2	2	D-4t	MASR_Off_2_2
		2	3	8	D-4u	MASR_Off_2_3
	2/Yes	1	3	1	D-4v	MASR_On_1_3
		2	2	1	D-4w	MASR_On_2_2
		2	3	8	D-4x	MASR_On_2_3

The number of phase centres used in each formed beam is a function of the DPCA mode. If no DPCA is turned off (DPCA Mode = None), then only one phase centre is used in each formed beam (see Figures D-4a to D-4e).

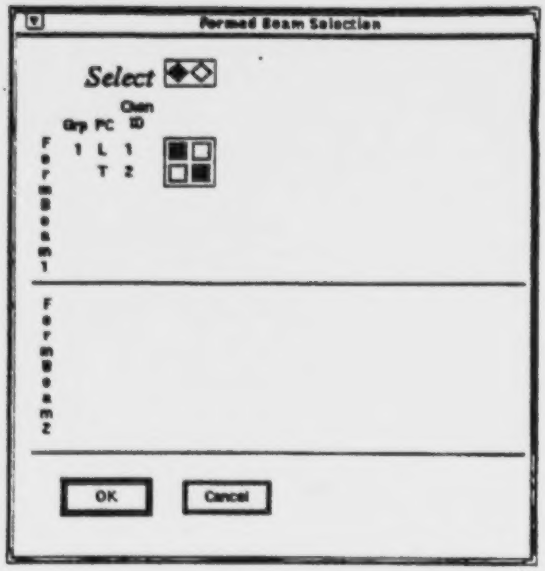
If ASAR is selected, the two phase centres are combined to form a beam (Figures D-4l to D-4q). ASAR pairs must be in the same group, but monopulse processing can be in a group or across groups (example: Figure D-4q).

If MASR is selected, then two or three phase centres can be combined (Figures D-4r to D-4x inclusive). Figures D-4s, D-4u and D-4x include 3-phase centre MASR choices.


Formed Beam Selection
Select ◆
Formed Beam 1
■
Formed Beam 2
OK
Cancel

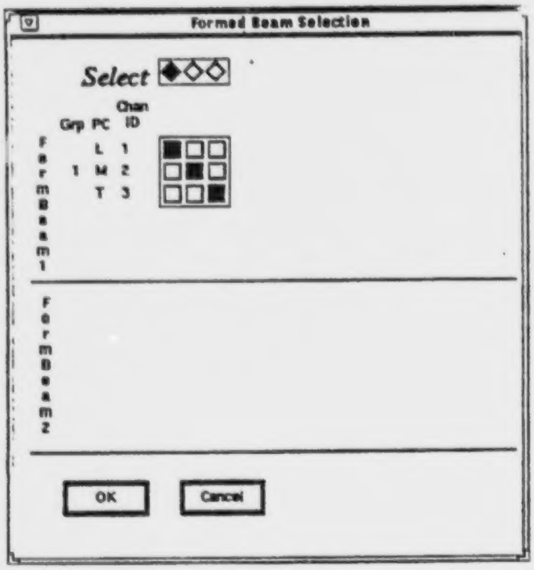
Grp	PC	Chan ID
1	L	1

Figure D-4a None_Off_1_1


Formed Beam Selection
Select ◆◇
Formed Beam 1
■□
□■
Formed Beam 2
OK
Cancel

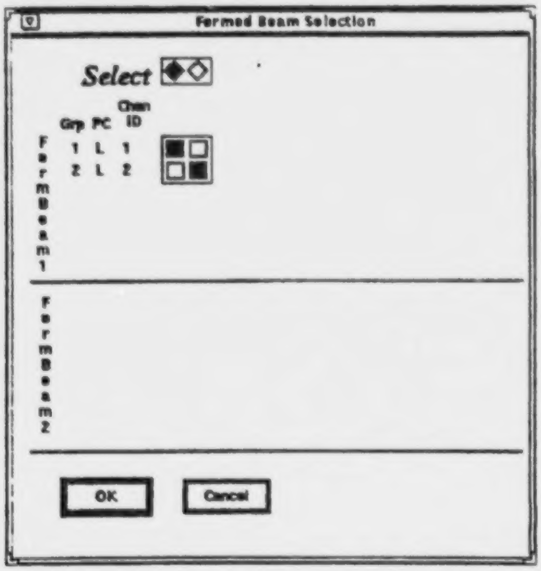
Grp	PC	Chan ID
1	L	1
	T	2

Figure D-4b None_Off_1_2


Formed Beam Selection
Select ◆◇◇
Formed Beam 1
■□□
□■□
□□■
Formed Beam 2
OK
Cancel

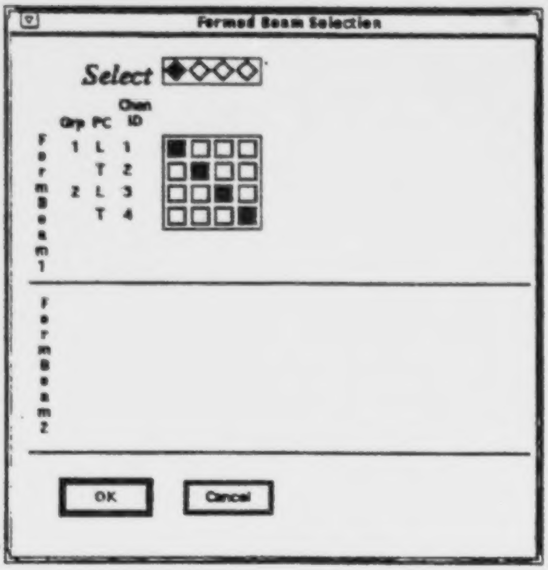
Grp	PC	Chan ID
	L	1
1	M	2
	T	3

Figure D-4c None_Off_1_3


Formed Beam Selection
Select ◆◇
Formed Beam 1
■□
□■
Formed Beam 2
OK
Cancel

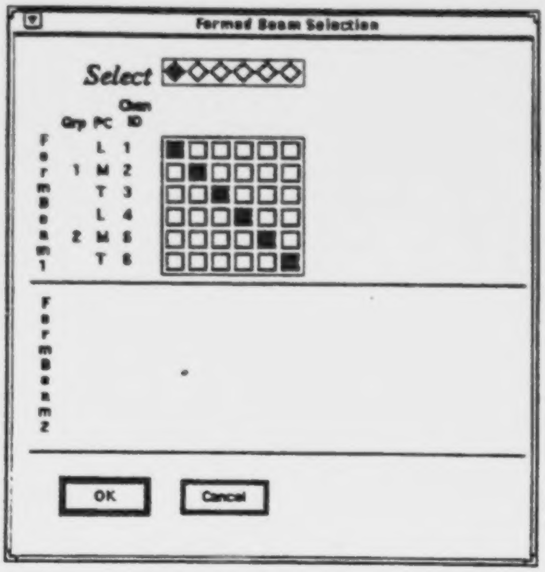
Grp	PC	Chan ID
1	L	1
2	L	2

Figure D-4d None_Off_2_1


Formed Beam Selection
Select ◆◇◇◇
Formed Beam 1
Formed Beam 2
OK
Cancel

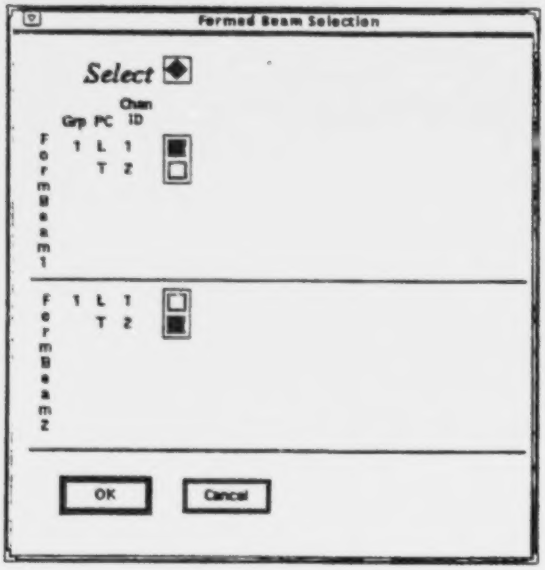
Grp	PC	Chan ID				
1	L	1	■	□	□	□
	T	2	□	■	□	□
2	L	3	□	□	■	□
	T	4	□	□	□	■

Figure D-4e None_Off_2_2


Formed Beam Selection
Select ◆◇◇◇◇◇
Formed Beam 1
Formed Beam 2
OK
Cancel

Grp	PC	Chan ID						
	L	1	■	□	□	□	□	□
1	M	2	□	■	□	□	□	□
	T	3	□	□	■	□	□	□
	L	4	□	□	□	■	□	□
2	M	5	□	□	□	□	■	□
	T	6	□	□	□	□	□	■

Figure D-4f None_Off_2_3


Formed Beam Selection
Select ◆
Formed Beam 1
Formed Beam 2
OK
Cancel

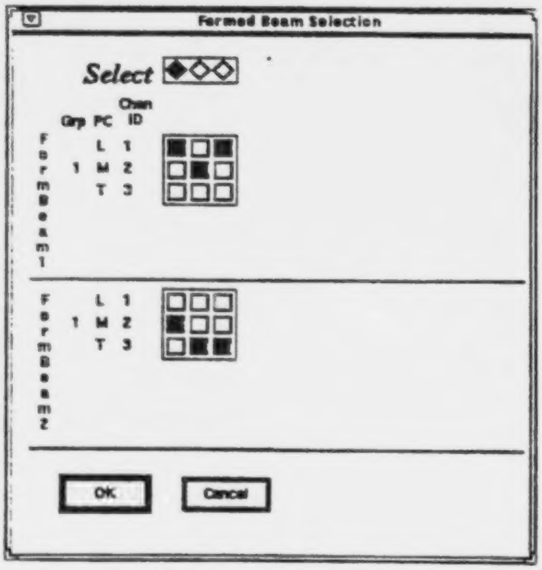
Formed Beam 1

Grp	PC	Chan ID	
1	L	1	■
	T	2	□

Formed Beam 2

Grp	PC	Chan ID	
1	L	1	□
	T	2	■

Figure D-4g None_On_1_2


Formed Beam Selection
Select ◆◇◇
Formed Beam 1
Formed Beam 2
OK
Cancel

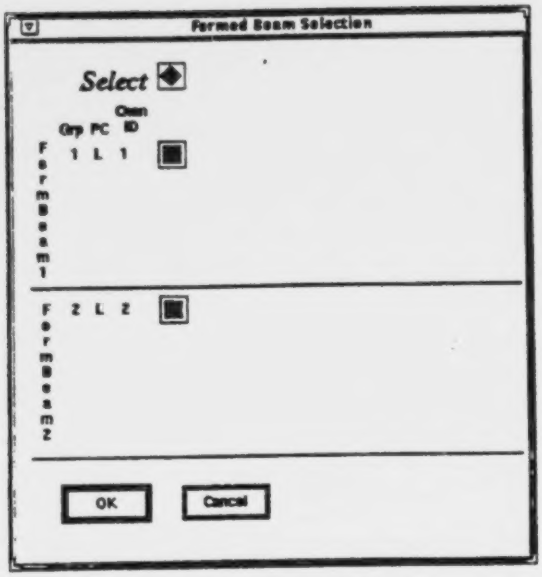
Formed Beam 1

Grp	PC	Chan ID			
	L	1	■	□	■
1	M	2	□	■	□
	T	3	□	□	□

Formed Beam 2

Grp	PC	Chan ID			
	L	1	□	□	□
1	M	2	■	□	□
	T	3	□	■	■

Figure D-4h None_On_1_3

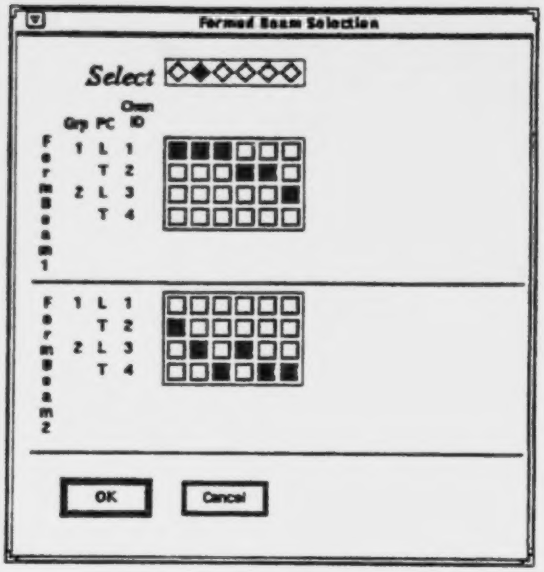

Formed Beam Selection
Formed Beam 1
Formed Beam 2
OK
Cancel

Select ◆

Grp	PC	Chan ID	
1	L	1	■

Grp	PC	Chan ID	
2	L	2	■

Figure D-4i None_On_2_1

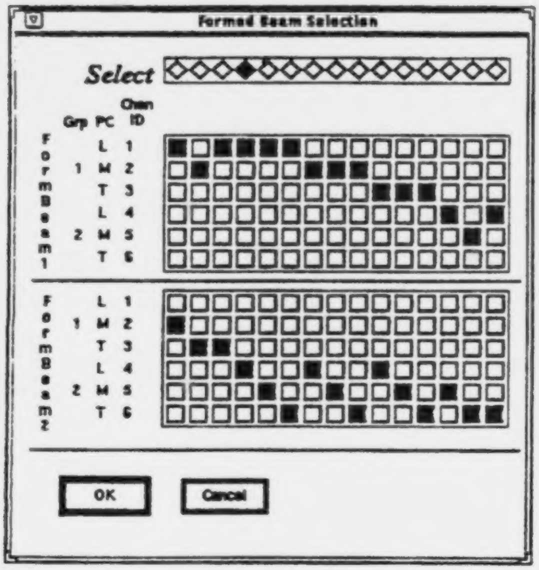

Formed Beam Selection
Formed Beam 1
Formed Beam 2
OK
Cancel

Select ◇◆◇◇◇◇

Grp	PC	Chan ID						
1	L	1	■	■	■	□	□	□
	T	2	□	□	□	■	■	□
2	L	3	□	□	□	□	□	■
	T	4	□	□	□	□	□	□

Grp	PC	Chan ID						
1	L	1	□	□	□	□	□	□
	T	2	■	□	□	□	□	□
2	L	3	□	■	□	■	□	□
	T	4	□	□	■	□	■	■

Figure D-4j None_On_2_2

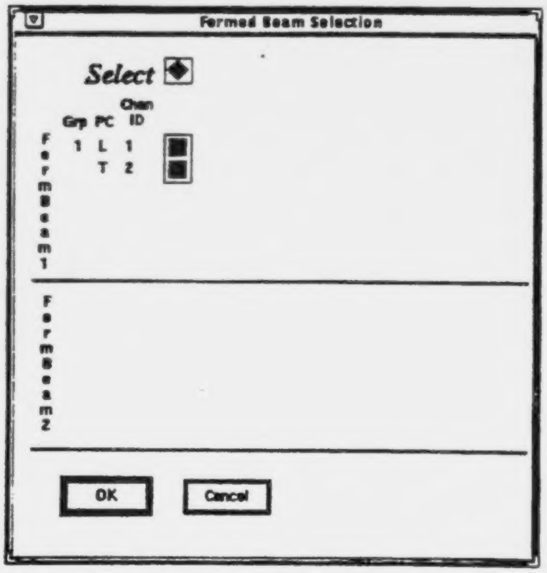

Formed Beam Selection
Formed Beam 1
Formed Beam 2
OK
Cancel

Select ◇◇◇◆◇◇◇◇◇◇◇◇◇◇◇

Grp	PC	Chan ID															
	L	1	■	□	■	■	■	■	□	□	□	□	□	□	□	□	□
1	M	2	□	■	□	□	□	□	■	■	■	□	□	□	□	□	□
	T	3	□	□	□	□	□	□	□	□	□	■	■	■	□	□	□
	L	4	□	□	□	□	□	□	□	□	□	□	□	□	■	□	■
2	M	5	□	□	□	□	□	□	□	□	□	□	□	□	□	■	□
	T	6	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□

Grp	PC	Chan ID															
	L	1	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
1	M	2	■	□	□	□	□	□	□	□	□	□	□	□	□	□	□
	T	3	□	■	■	□	□	□	□	□	□	□	□	□	□	□	□
	L	4	□	□	□	■	□	□	■	□	□	■	□	□	□	□	□
2	M	5	□	□	□	□	■	□	□	■	□	□	■	□	■	□	□
	T	6	□	□	□	□	□	■	□	□	■	□	□	■	□	■	■

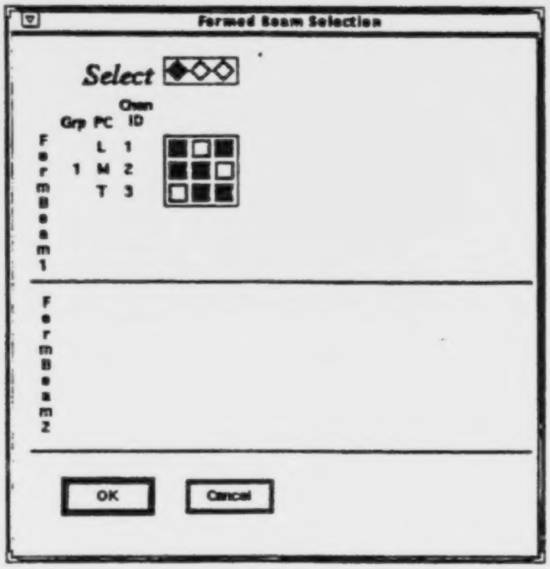
Figure D-4k None_On_2_3


Formed Beam Selection
Formed Beam 1
Formed Beam 2
OK
Cancel

Select ◆

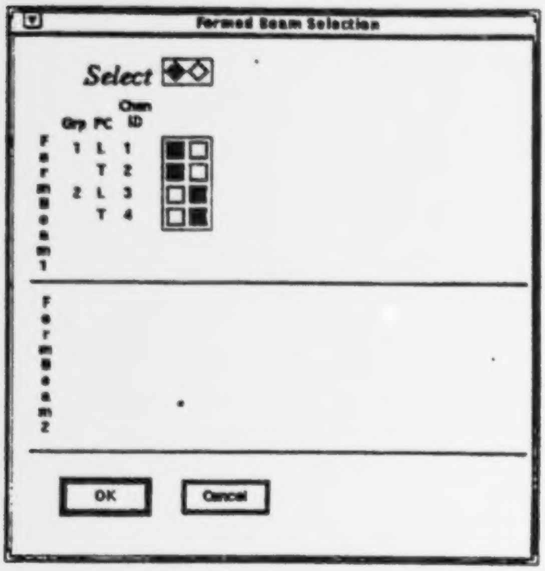
Grp	PC	Chan ID	
1	L	1	■
	T	2	■

Figure D-4l None_Off_1_2


Formed Beam Selection
Select ◆◇◇
Formed Beam 1
Formed Beam 2
OK
Cancel

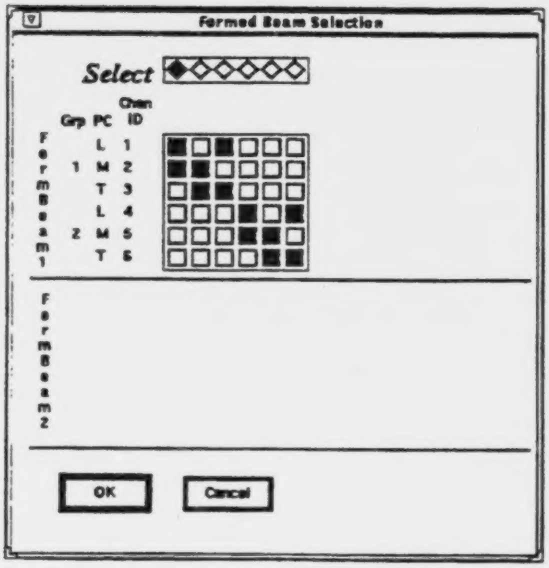
Grp	PC	Chan ID			
	L	1	■	□	■
1	M	2	■	■	□
	T	3	□	■	■

Figure D-4m ASAR_Off_1_3


Formed Beam Selection
Select ◆◇
Formed Beam 1
Formed Beam 2
OK
Cancel

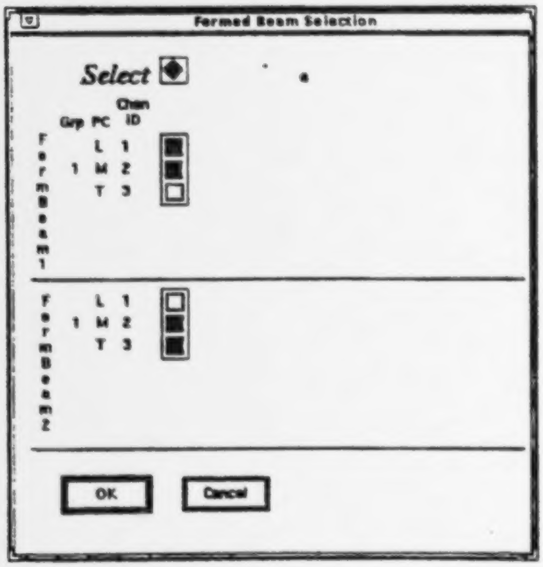
Grp	PC	Chan ID		
1	L	1	■	□
	T	2	■	□
2	L	3	□	■
	T	4	□	■

Figure D-4n ASAR_Off_2_2


Formed Beam Selection
Select ◆◇◇◇◇◇
Formed Beam 1
Formed Beam 2
OK
Cancel

Grp	PC	Chan ID						
	L	1	■	□	■	□	□	□
1	M	2	■	■	□	□	□	□
	T	3	□	■	■	□	□	□
	L	4	□	□	□	■	□	■
2	M	5	□	□	□	■	■	□
	T	6	□	□	□	□	■	■

Figure D-4o None_Off_2_3


Formed Beam Selection
Select ◆
Formed Beam 1
Formed Beam 2
OK
Cancel

Formed Beam 1

Grp	PC	Chan ID	
	L	1	■
1	M	2	■
	T	3	□

Formed Beam 2

Grp	PC	Chan ID	
	L	1	□
1	M	2	■
	T	3	■

Figure D-4p ASAR_On_1_3

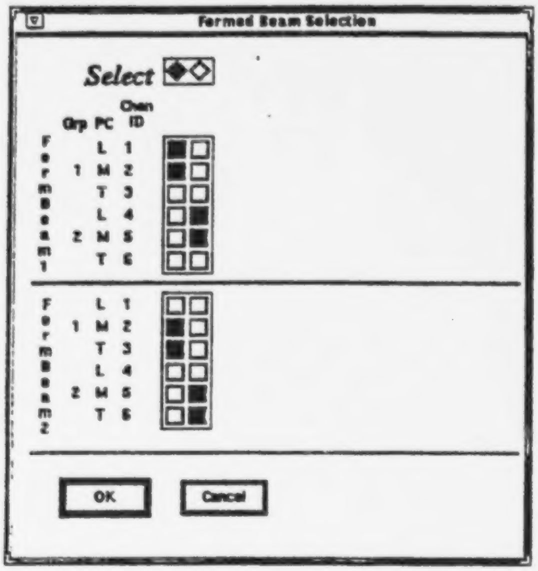

Formed Beam Selection
Select ◆◇
Grp PC Chan ID
Formed Beam 1
L 1 ■□
1 M 2 ■□
T 3 □□
L 4 □■
2 M 5 □■
T 6 □□
Formed Beam 2
L 1 □□
1 M 2 ■□
T 3 ■□
L 4 □□
2 M 5 □■
T 6 □■
OK
Cancel

Figure D-4q ASAR_On_2_3

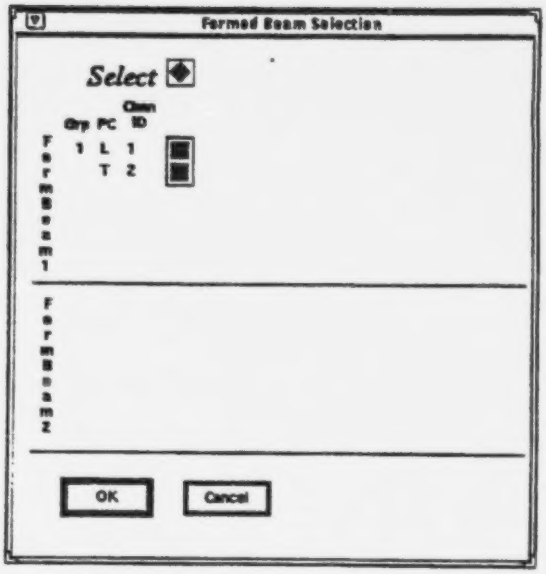

Formed Beam Selection
Select ◆
Grp PC Chan ID
Formed Beam 1
1 L 1 ■
T 2 ■
Formed Beam 2
OK
Cancel

Figure D-4r MASR_Off_1_2

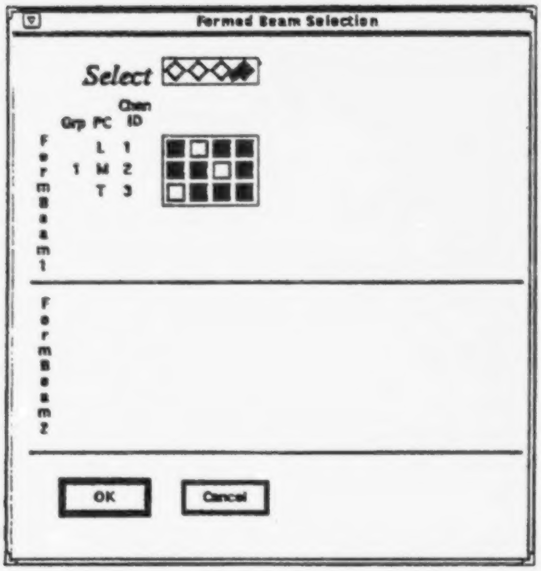

Formed Beam Selection
Select ◇◇◇◆
Grp PC Chan ID
Formed Beam 1
L 1 ■□■■
1 M 2 ■■□■
T 3 □■■■
Formed Beam 2
OK
Cancel

Figure D-4s MASR_Off_1_3

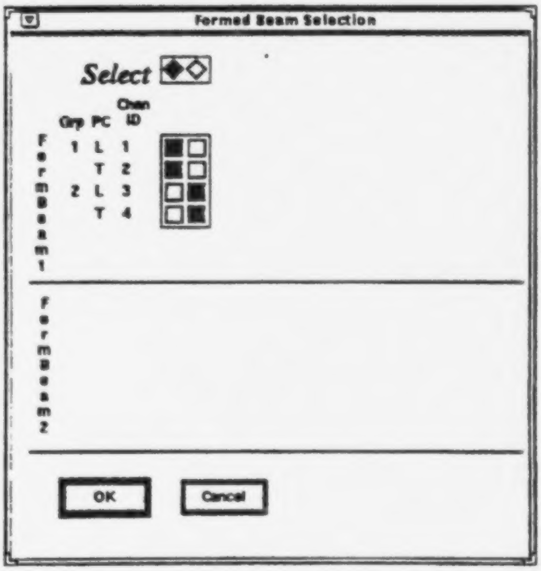
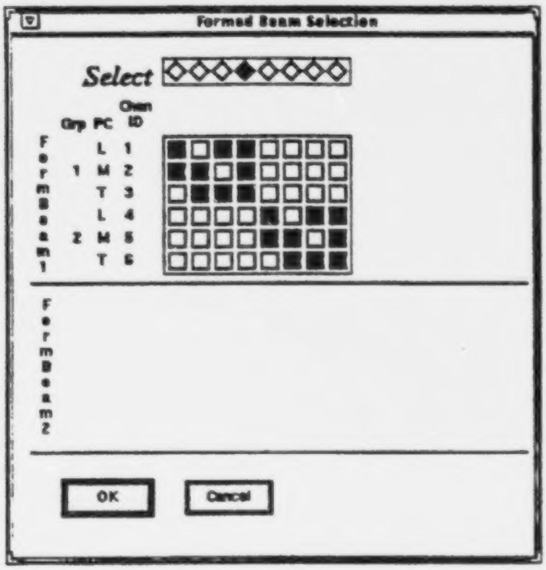

Formed Beam Selection
Select ◆◇
Grp PC Chan ID
Formed Beam 1
1 L 1 ■□
T 2 ■□
2 L 3 □■
T 4 □■
Formed Beam 2
OK
Cancel

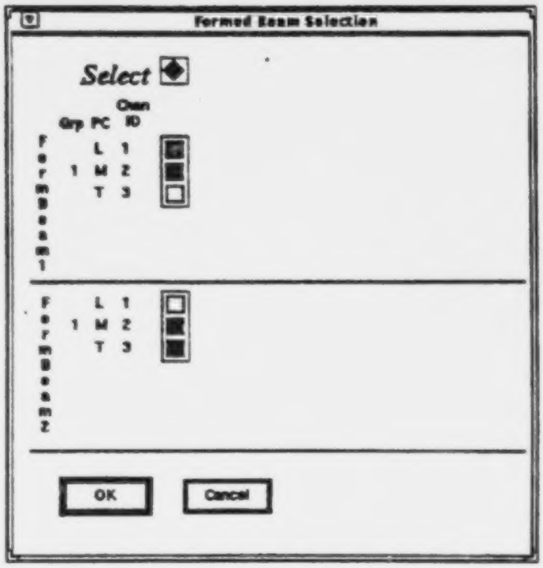
Figure D-4t MASR_Off_2_2


Formed Beam Selection
OK
Cancel

Select ◇◇◇◆◇◇◇◇

	Grp	PC	Chan ID								
Form Beam 1		L	1	■	□	■	■	□	□	□	□
	1	M	2	■	■	□	■	□	□	□	□
		T	3	□	■	■	■	□	□	□	□
		L	4	□	□	□	□	■	□	■	■
	2	M	5	□	□	□	□	■	■	□	■
		T	6	□	□	□	□	□	■	■	■
Form Beam 2											

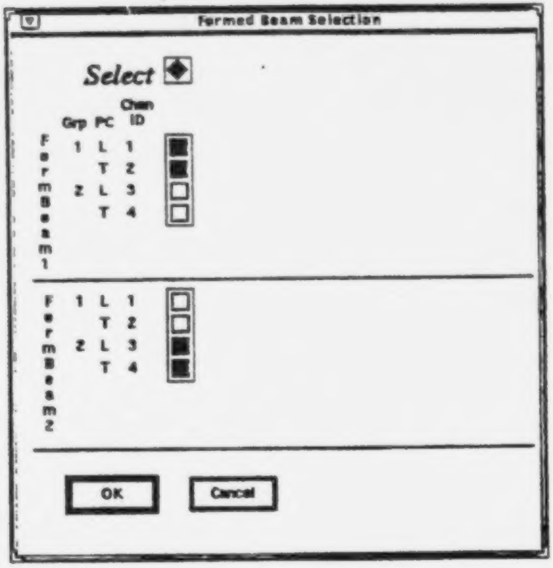
Figure D-4u MASR_Off_2_3


Formed Beam Selection
OK
Cancel

Select ◆

	Grp	PC	Chan ID	
Form Beam 1		L	1	■
	1	M	2	■
		T	3	□
Form Beam 2		L	1	□
	1	M	2	■
		T	3	■

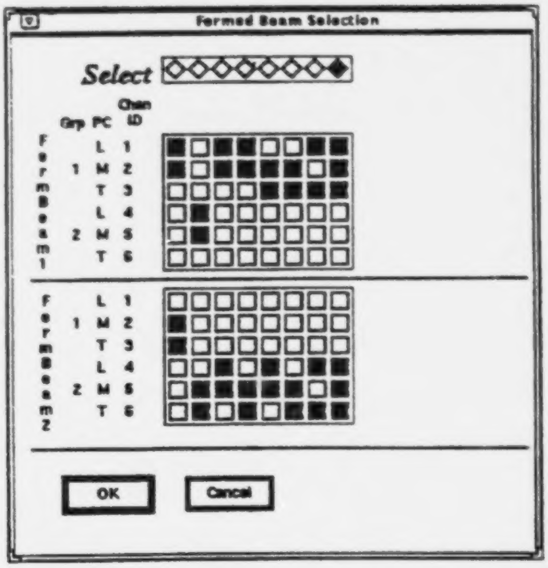
Figure D-4v MASR_On_1_3


Formed Beam Selection
OK
Cancel

Select ◆

	Grp	PC	Chan ID	
Form Beam 1	1	L	1	■
		T	2	■
	2	L	3	□
		T	4	□
Form Beam 2	1	L	1	□
		T	2	□
	2	L	3	■
		T	4	■

Figure D-4w MASR_On_2_3


Formed Beam Selection
OK
Cancel

Select ◇◇◇◇◇◇◇◆

	Grp	PC	Chan ID								
Form Beam 1		L	1	■	□	■	■	□	□	■	■
	1	M	2	■	□	■	■	■	■	□	■
		T	3	□	□	□	□	■	■	■	■
		L	4	□	■	□	□	□	□	□	□
	2	M	5	□	■	□	□	□	□	□	□
		T	6	□	□	□	□	□	□	□	□
Form Beam 2		L	1	□	□	□	□	□	□	□	□
	1	M	2	■	□	□	□	□	□	□	□
		T	3	■	□	□	□	□	□	□	□
		L	4	□	□	■	□	■	□	■	■
	2	M	5	□	■	■	■	■	■	□	■
		T	6	□	■	□	■	□	■	■	■

Figure D-4x MASR_On_2_3

D2.1.2 Blanker Selection

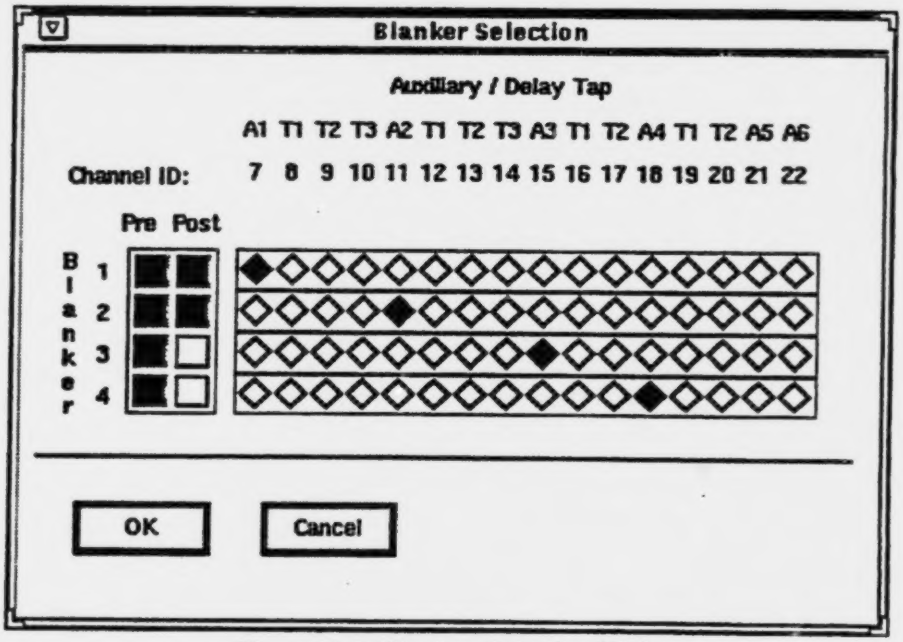
This dialogue (Figure D-5) is used to select auxiliaries to be used for pre-Doppler and range-Doppler blanking for one run. It is accessed from the DSP Configuration dialogue by selecting "Define Blankers".

Figure D-5 shows the Blanker Selection dialogue with the maximum number of pre-Doppler (4) and post-Doppler (2) (or range-Doppler) blanker channels and auxiliaries. The left side of the dialogue shows the number of each type of blanker in the form of a display-only button grid. The number of blankers enabled (shown with a "filled" button) is that previously set in the DSP Configuration dialogue.

Auxiliary and delay tap channels are listed across the top of the dialogue with their channel acronym and numeric channel ID, derived from the Satellite/Radar definition following the logic described in A1.2.4 and A1.2.5.

The user-selectable area of the dialogue consists of four radio button rows, one row for each blanker. An auxiliary channel is selected for blanking by toggling the radio button under the corresponding auxiliary. Only one auxiliary or delay tap is enabled to reach blanker channel. Normally different auxiliaries are selected for blanker channels.

Default blanker selection has first auxiliary (A1) assigned to blanker channel 1, second auxiliary (A2) assigned to blanker Channel 2, up to the total number of blankers enabled.



Auxiliary / Delay Tap

Blanker	Pre	Post	A1	T1	T2	T3	A2	T1	T2	T3	A3	T1	T2	A4	T1	T2	A5	A6
Channel ID:			7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	■	■	◆	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇
2	■	■	◇	◇	◇	◇	◆	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇
3	■	☐	◇	◇	◇	◇	◇	◇	◇	◇	◆	◇	◇	◇	◇	◇	◇	◇
4	■	☐	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◆	◇	◇	◇	◇

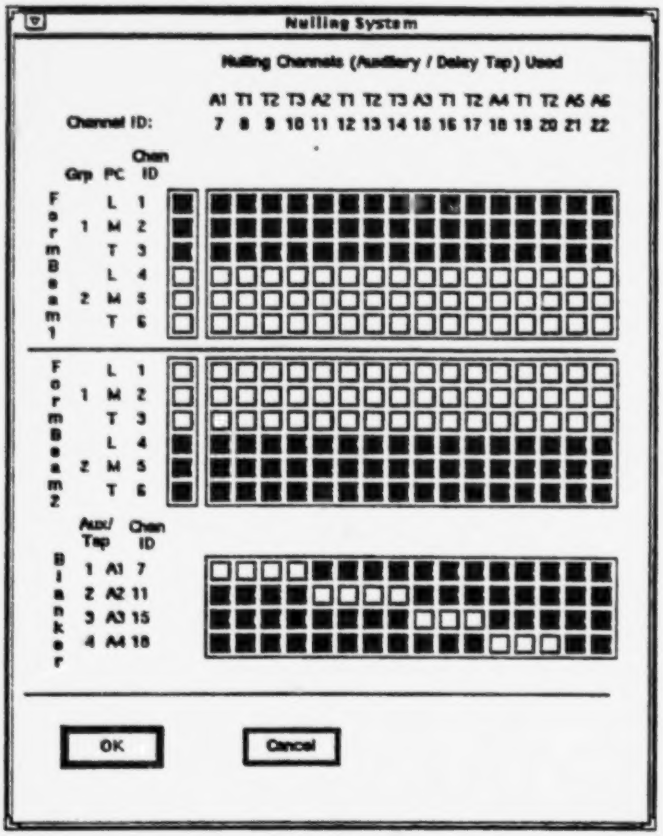
Figure D-5 Blanker Selection Dialogue

D2.1.3 Nulling Systems

This dialogue (Figure D-6) is used to specify auxiliary channels for use in nulling main phase centres and blankers for one run. This dialogue is accessed from the DSP Configuration dialogue by selecting "Define Nulling Systems".

Figure D-6 shows the Nulling Systems dialogue with a maximum number of main beams (2 groups of 3 phase centres), 16 auxiliaries and tap delay channels, and four blanker channels. There are two grid button areas:

• Formed Beams	Nulling channels for main phase centres
• Blankers	Nulling channels for pre-Doppler and range-Doppler blankers.



Nulling System

Nulling Channels (Auxiliary / Delay Tap) Used

	Grp	PC	Chan ID		A1	T1	T2	T3	A2	T1	T2	T3	A3	T1	T2	A4	T1	T2	A5	A6
Channel ID:					7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Form Beam 1	1	L	1	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
		M	2	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
		T	3	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	2	L	4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
		M	5	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
		T	6	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Form Beam 2	1	L	1	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
		M	2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
		T	3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	2	L	4	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
		M	5	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
		T	6	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
		Aux/ Tap	Chan ID																	
Blanker	1	A1	7		☐	☐	☐	☐	■	■	■	■	■	■	■	■	■	■	■	■
	2	A2	11		■	■	■	■	☐	☐	☐	☐	■	■	■	■	■	■	■	■
	3	A3	15		■	■	■	■	■	■	■	■	☐	☐	☐	■	■	■	■	■
	4	A4	18		■	■	■	■	■	■	■	■	■	■	■	☐	☐	☐	■	■

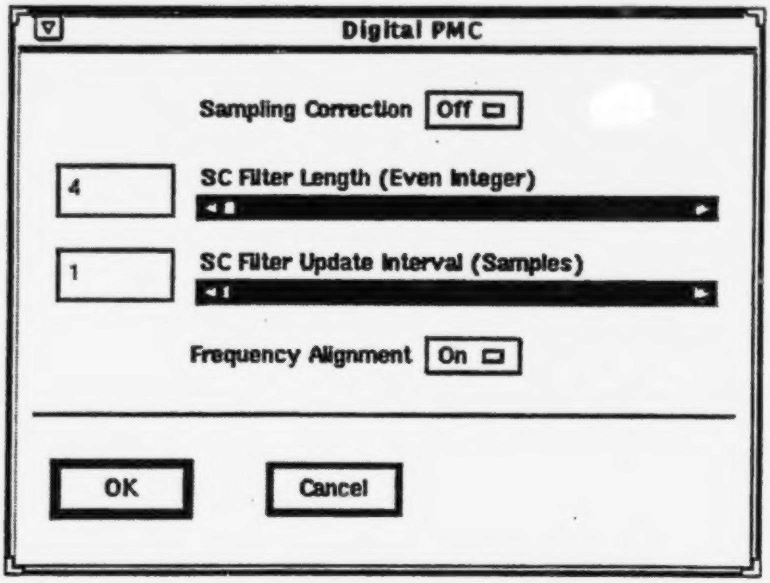
Figure D-6 Nulling Systems Dialogue

On the left side of the dialogue lists the formed beams with their channel acronyms and channel identifiers. Similarly blankers previously selected in Blanker Selection are listed. Nulling channels (auxiliaries and delay taps) are listed at the top.

The grid button areas allow selection of auxiliaries to be used in nulling a main channel or blanker. Any combination of auxiliaries may be used to null main phase centre or blanker, except blankers may not be nulled by itself or its own tap delays. These choices are restricted in the HMI logic. An auxiliary is enabled for nulling when its corresponding button is "filled". Nulling Systems defaults to nulling fully enabled with all auxiliaries nulling all main phase centres and blankers, except itself.

D2.2 Digital PMC

This dialogue (Figure D-7) is used to specify parameters related to the Sampling Correction and Frequency Alignment functions in the ESP, fixed for a run. It is accessed from the top-level Simulation Run dialogue by selecting the Digital PMC button in the CTI level.


Digital PMC

Sampling Correction: Off

SC Filter Length (Even Integer): 4

SC Filter Update Interval (Samples): 1

Frequency Alignment: On

Figure D-7 Digital PMC Dialogue

Sampling Correction (SC) is used to enable/disable digital sampling correction in the ESP. SC performs the digital equivalent of PRF adjustment or analogue motion compensation. Digital SC is normally enabled if analog receiver motion compensation (selected in Satellite/Radar Definition: Receiver Front End dialogue) is turned off.

Selection: Digital SC On, Off

Defaults:

On (if analogue mocomp off)
Off (if analogue mocomp on)

SC Filter Length specifies the number of coefficients in the digital SC filter:

Range:	4 to 32 (even integer)
Default:	4

SC Filter Update Interval specifies the filter Update Interval (*UI*) in input signal samples. This is the number of samples between updates to the filter $h_{cl}(x)$ in the DSP algorithm equation (A.8) in Document R-7. The update interval trades off filter accuracy against computational throughput, with a value of "1" producing a filter update every input sample

Range:	1 to 10,000
Default:	1 (update every sample)

Frequency Alignment is used to enable/disable the Frequency Alignment (FA) function in the ESP (Document R-7, Appendix A7). FA performs a Doppler frequency shift on the signal, shifting the clutter spectrum to lie at DC (zero frequency).

Range:	Off, On (default)

D2.3 Adaptive Nulling

This dialogue box (Figure D-8) is used to select parameters associated with adaptive nulling in the ESP. The nulling parameters are fixed for one run. This dialogue is accessed from the top-level Simulation Run dialogue by selecting the "Adaptive Nulling" bottom in the CTI level. Adaptive nulling is used to coherently cancel sidelobe noise jammer signals and is described in Document R-7, Appendix A4.

Snapshot Smoothing Period specifies the total time interval over which the nulling weights are smoothed (see Figure D-8a). If the number of update intervals per smoothing interval is set to 1, then this time is also equal to the weight vector update period T_w.

Range:	0.1 to 10.0 ms
Default:	0.5 ms (RRA) 5.0 ms (CFA)

Snapshots per Smoothing Interval specifies the number of Snapshots (sample vectors) taken for each weight vector update interval (I_k).

Range: 1 to 100 (integer)
Default: 30 (RRA)
65 (CFA)

Update Intervals per Smoothing Interval specifies the number of update intervals that are smoothed (averaged) to produce the effective weight vector for each interval. Smoothing is symmetric about each update interval (see Figure D-8a), hence the smoothing interval is odd.

Range: 1 to 99 (odd integer)
Default 1

Snapshot Selection specifies the algorithm used to choose which sample times are used in weight vector update (Document R-7, A4.2.2.3). Two are provided: Uniform (default), and Pseudo-Random.

Snapshot Editing specifies the type of snapshot editing from the following: None (default), Reject High-Power, Reject Low-Power.

Number Rejected specifies the number of snapshots rejected if Reject High-Power or Reject Low-Power editing is selected. The HMI range is fixed to 1 (default) to 100, but the number rejected must be less than the number of snapshots per smoothing interval to be valid.

Notch Filter Length specifies the length of the MTI notch filter (Document R-7, Appendix A4.2.2.1) over the fixed range 1, 3 (default), 5, 7. The notch filter is applicable only if DPCA is not selected. This selection is dimmed if MASR or ASAR DPCA is enabled. Filter length of 1 means no filter is used.

Notch Filter Weights provide two choices of MTI filter: Binomial MTI (default), User-Entered Weights. Binomial MTI weights are as follows:

Length	**Weights**
3	-1, 2, -1
5	1, -4, 6, -4, 1
7	-1, 6, -15, 20, -15, 6, -1

User-Entered Weights is enabled if the above weight selection is "User-Entered". Weights are entered as complex-valued coefficients (I = real part, Q = imaginary part).

Range of Value: Any floating-point value (real and imaginary parts).

Diagonal Loading Constant specifies the diagonal loading constant (δ) in the covariance matrix (Document R-7, Appendix A4.2.3.3).

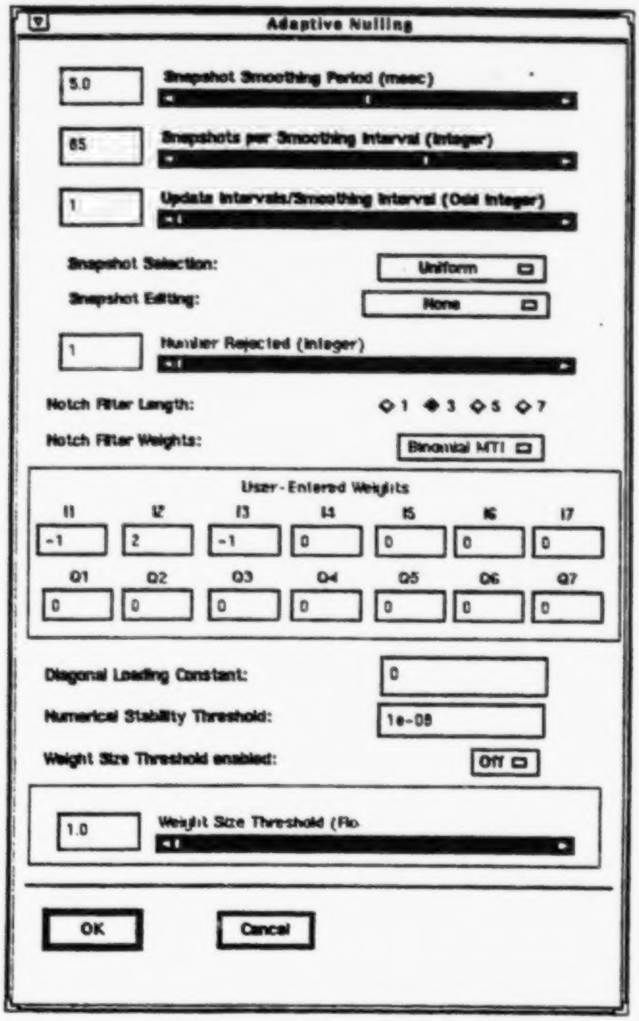
Range: 9 (default, off) to 10^{-3}

Numerical Stability Threshold specifies the numerical stability threshold (Λ_E) in the Cholesky factorization (Document R-7, Appendix A4.2.4).

Range:	0 to 10^{-3}
Default:	10^{-8}

Weight Size Threshold Enabled specifies whether the weight size threshold is applied in Cholesky factorization (Document R-7, Appendix A4.2.4), and is either On or Off (default).

Weight Size Threshold specifies the threshold value (Λ_w) in the range 1.0 to 10,000. Default value: 100.0.



Snapshot Smoothing Period (msec): 5.0

Snapshots per Smoothing Interval (Integer): 85

Update Intervals/Smoothing Interval (Odd Integer): 1

Snapshot Selection: Uniform

Snapshot Editing: None

Number Rejected (Integer): 1

Notch Filter Length: ◇ 1 ◆ 3 ◇ 5 ◇ 7

Notch Filter Weights: Binomial MTI

User-Entered Weights

I1	I2	I3	I4	I5	I6	I7
-1	2	-1	0	0	0	0
Q1	Q2	Q3	Q4	Q5	Q6	Q7
0	0	0	0	0	0	0

Diagonal Loading Constant: 0

Numerical Stability Threshold: 1e-08

Weight Size Threshold enabled: Off

Weight Size Threshold (Flo: 1.0

Figure D-8 Adaptive Nulling Dialogue

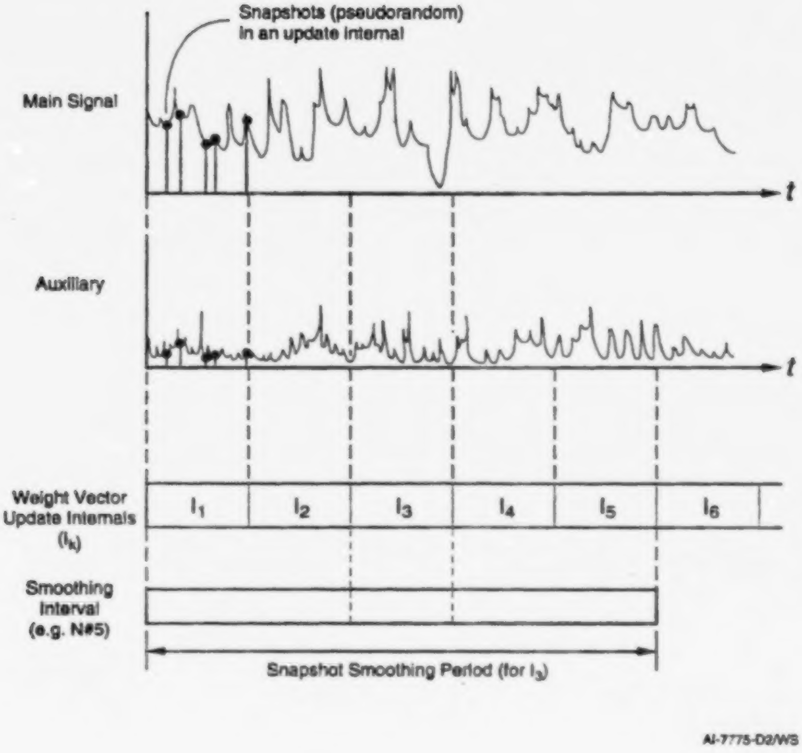

Snapshots (pseudorandom) in an update internal
Main Signal
t
Auxiliary
t
Weight Vector Update Internals (I_k)
I_1
I_2
I_3
I_4
I_5
I_6
Smoothing Interval (e.g. N=5)
Snapshot Smoothing Period (for I_3)
AI-7775-D2/WS

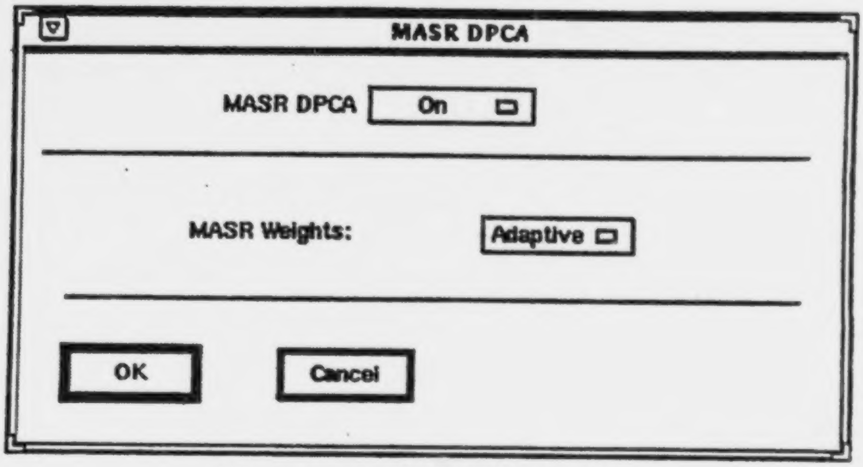
Figure D-8a Adaptive Nulling Snapshot/Update/Smoothing Intervals

D2.4 Pre-Doppler Blanking

This dialogue (Figure D-9) is used to specify pre-doppler blanking parameters which are fixed for a run. It is accessed from the top-level dialogue by selecting "Pre-Doppler Blanking" at the CTI level. The pre-Doppler blanking algorithm and its parameters are described in Document R-7, Appendix A5., "Pre-Doppler Blanking".

Noise Threshold specifies the noise threshold parameter (Λ_n) in the pre-Doppler blanking algorithm (Document R-7, Equation A-23).

Range:	0 to 10^4
Default:	100



MASR DPCA: On

MASR Weights: Adaptive

Figure D-10 MASR DPCA Dialogue

D2.6 Pulse Doppler

This dialogue (Figure D-11) is used to specify pulse Doppler processing parameters which are fixed for a run. It is accessed from the top-level dialogue by selecting "Pulse Doppler" in the CTI level (Document R-7, Appendix A9.).

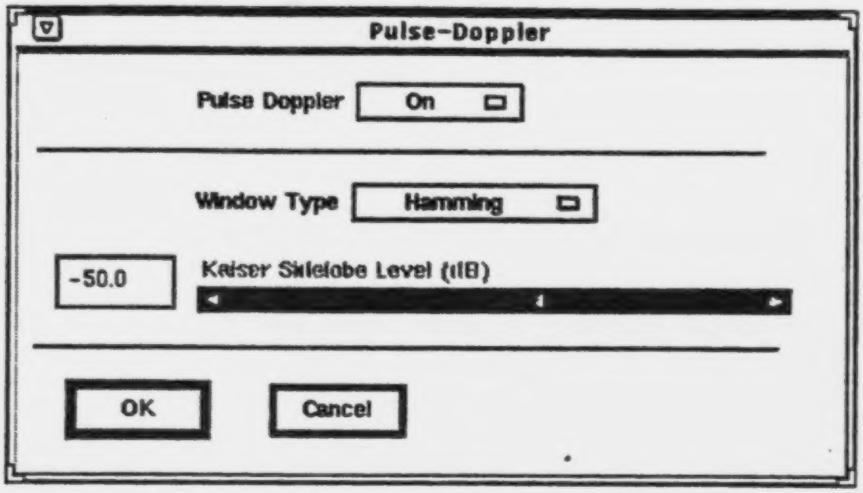
Pulse Doppler may be enabled/disabled by this selector: **On** (default) enables the forward FFT for time/Doppler transformation and coherent processing of the pulses in one burst. **Bypassed** disables the forward FFT for non-coherent time-domain processing of the range/pulse matrix.

Window Type selects the type of window function applied before the FFT to control Doppler sidelobes. The following choices are provided:

- Uniform;
- Hamming (default);
- Hann;
- Blockman;
- Kaiser (enter sidelobe level);
- Blockman-Harris.

Kaiser Sidelobe Level specifies the Kaiser window beta (β) parameter in terms of the first sidelobe level relative to the main lobe in dB.

Range:	-100 to -13 dB
Defaults:	-50 dB



Pulse Doppler: On

Window Type: Hamming

Kaiser Sidelobe Level (dB): -50.0

Figure D-11 Pulse Doppler Dialogue

D2.7 ESP Data Capture Options

This dialogue box (Figure D-12) is used to select ESP intermediate results for capture during a run. It is accessed from the top-level dialogue through the "ESP Data Capture" button at the CTI level.

The ESP Data Capture Options dialogue consists of selector buttons that are toggled on/off by clicking the mouse pointer. The buttons default t all "Off" (not filled, light coloured). Any combination of main and auxiliary channels may be selected for capture by enabling the corresponding button.

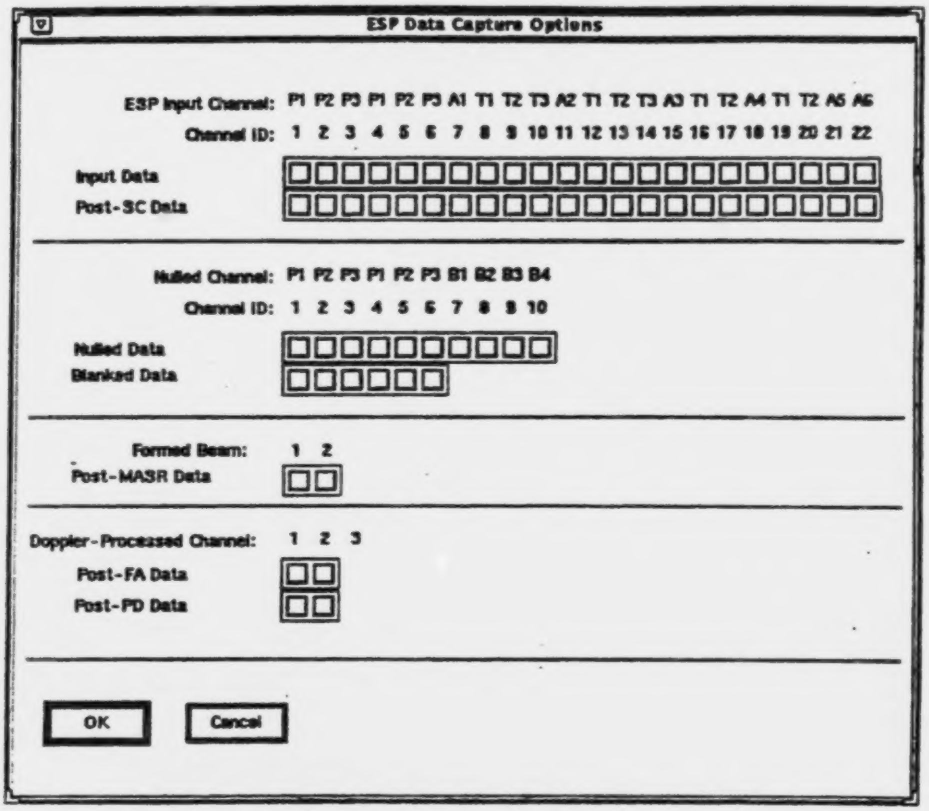
Input Data and **Post-SC Data** are captured before any channels are combined. Figure D-12 illustrates an example with two groups of three main phase centres (P1 P2 P3 P1 P2 P3), and 16 auxiliary and tap delay channels.

Nulled Data contains main phase centres and blanker channels. In this figure, four pre-Doppler blanker channels (B1 ... B4) are available.

Blanked Data contains main centres only.

Post-MASR Data allows selection of the formed monopulse beams after main phase centres have been combined to cancel clutter. If monopulse is enabled, there are two formed beams, otherwise there is one formed beam. Range-Doppler blanker channels are not included in post-MASR data capture.

Doppler-Accessed Signals; **Post-FA** and **Post-PD** contain main phase centres or formed beams, and range-Doppler blanker channels, if any are enabled. The maximum number of channels in these signals is 3.



ESP Data Capture Options

ESP Input Channel: P1 P2 P3 P1 P2 P3 A1 T1 T2 T3 A2 T1 T2 T3 A3 T1 T2 A4 T1 T2 A5 A6
Channel ID: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
Input Data ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
Post-SC Data ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Nulled Channel: P1 P2 P3 P1 P2 P3 B1 B2 B3 B4
Channel ID: 1 2 3 4 5 6 7 8 9 10
Nulled Data ☐☐☐☐☐☐☐☐☐☐
Blanked Data ☐☐☐☐☐☐

Formed Beam: 1 2
Post-MASR Data ☐☐

Doppler-Processed Channel: 1 2 3
Post-FA Data ☐☐
Post-PD Data ☐☐

Figure D-12 ESP Data Capture Options

D2.8 ESP Products

This dialogue box is used to select ESP adaptive nulling and pulse Doppler equation products which are fixed for a run. It is accessed from the top-level dialogue by selecting "ESP Products" at the CTI level. All equation products default to disabled or "Off".

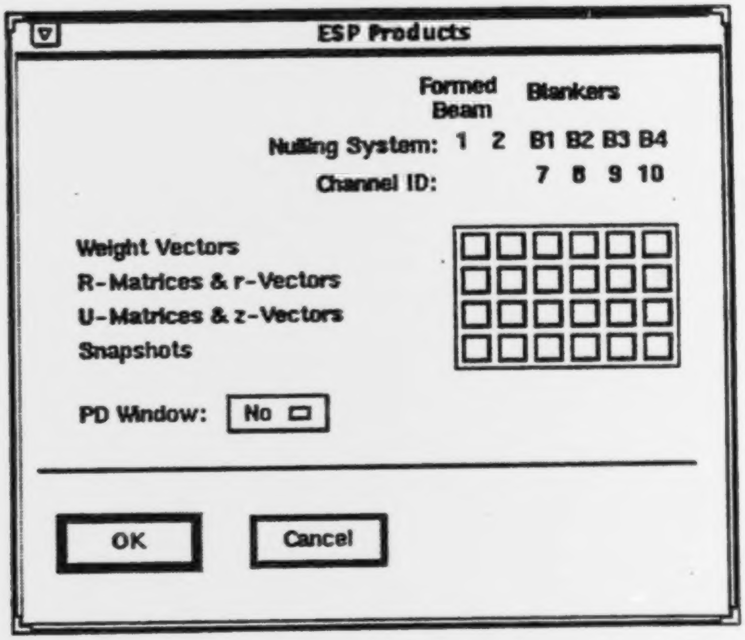
The following adaptive nulling equation products are selectable for each nulling system and each blanker channel:

- Weight Vectors;
- R-Matrices and r-vectors (correlation matrices);
- U-Matrices and z-vectors (Cholesky factor and forward elimination result);
- Snapshots.

Refer to Document R-7, Appendix A4 for further details of these variables in the algorithms. Refer to Document R-9, section 3.2.1.7.16, .17 and .19 for description of the intermediate product format.

Note: *In SPD version 4.1 (November 1994), the capture of the adaptive nulling equation products has not been implemented in the ESP software.)*

PD Window enables capture of the pulse Doppler window function which is updated once per dwell. (The interval of the pulse Doppler FFT length may be updated.)



ESP Products

Nulling System:	1	2	B1	B2	B3	B4
Channel ID:			7	8	9	10
Weight Vectors	☐	☐	☐	☐	☐	☐
R-Matrices & r-Vectors	☐	☐	☐	☐	☐	☐
U-Matrices & z-Vectors	☐	☐	☐	☐	☐	☐
Snapshots	☐	☐	☐	☐	☐	☐

PD Window: No

Figure D-13 ESP Products Dialogue

D2.9 Pulse Compression

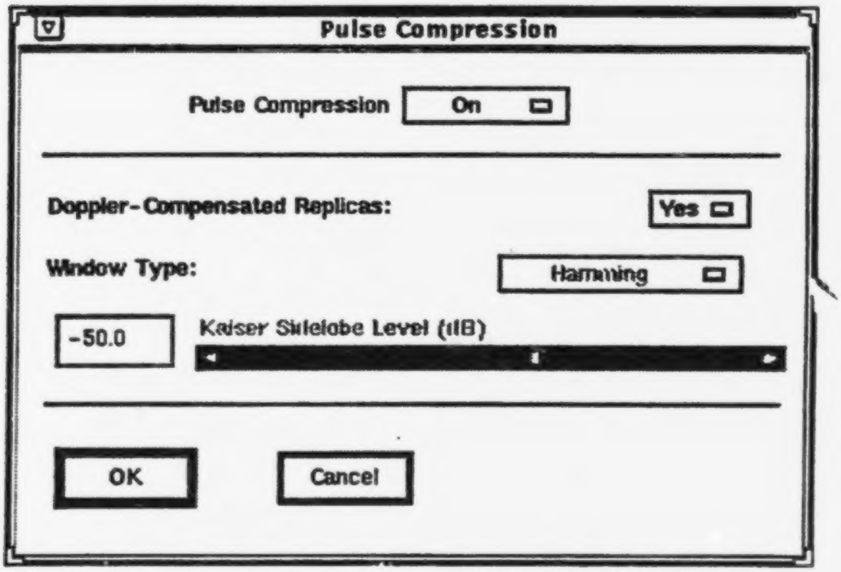
This dialogue (Figure D-14) is used to select pulse compression parameters which are fixed for a run. It is accessed from the top-level dialogue through the "Pulse Compression" button at the CTI level (Document R-7, Appendix A10.).

Pulse Compression may be enabled/disabled by this selector. **On** (default) enables the range matched filter processing to perform pulse compression. **Bypassed** turns off pulse compression and passes uncompressed range/Doppler matrices to DPCA and non-coherent integration.

Doppler-Compensated Replicas is used to enable/disable Doppler frequency correction of the pulse compression matched filters, also known as "tuned replicas". **Yes** (default) enables the Doppler compensation algorithm. This causes 11 tuned replicas to be computed, spaced evenly (with the centre one at DC) across the Doppler spectrum (augmented Doppler if PC Doppler Augment is selected). **No** disables Doppler compensation and uses one untuned replica at DC.

Window Type selects the type of window function applied in the frequency domain to the matched filters. The pulse compression window is enabled for LFM waveforms only. NLFM compression is unweighted. Pulse compression windowing is used to control time-domain or range sidelobes in the compressed output. The same choices as pulse Doppler windowing are provided:

- Uniform;
- Hamming (default)
- Hann;
- Blockman;
- Kaiser (enter sidelobe level);
- Blockman-Harris.



Pulse Compression: On

Doppler-Compensated Replicas: Yes

Window Type: Hamming

Kaiser Sidelobe Level (dB): -50.0

Figure D-14 Pulse Compression Dialogue

D2.10 ASAR DPCA

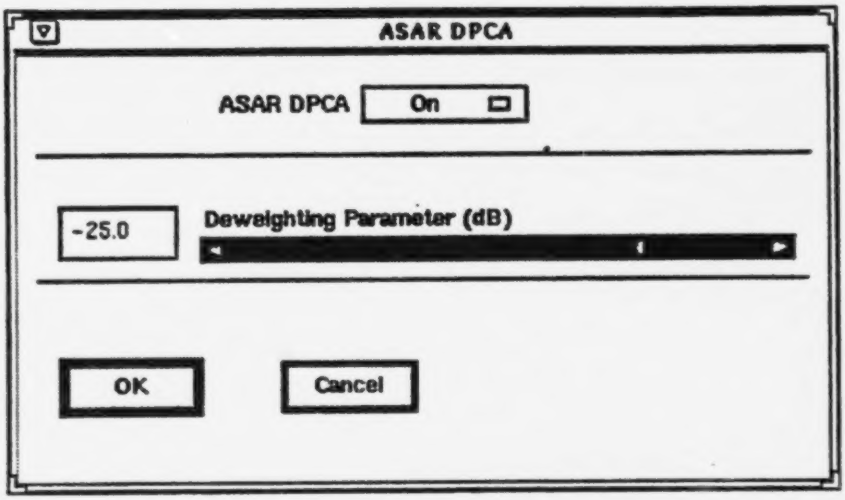
This dialogue box (Figure D-15) is used to specify ASAR DPCA processing parameters which are fixed for a run. It is accessed from the top-level Simulation Run dialogue by selecting "ASAR DPCA" at the CTI level. This dialogue is accessible only if ASAR DPCA is selected in the DSP configuration (Document R-7, Appendix A11).

ASAR DPCA is used to enable or bypass the ASAR processing if the DSP is configured for ASAR DPCA. **On** (default) enables the ASAR algorithm, performing channel combination and clutter cancellation. **Bypassed** disables ASAR, effectively reverting the processor to a pulse Doppler mode.

Deweighting Parameter specifies the input target to clutter ratio (α) used to compute the target deweighting threshold, and is entered as a power ratio in dB.

Range: -100 to 0 dB
Default: -25 dB

Target deweighting is used to "deweight" or reject strong discrete scatterers from influencing the ASAR DPCA weight computed for each Doppler velocity.



ASAR DPCA On

-25.0 Deweighting Parameter (dB)

Figure D-15 ASAR DPCA Dialogue

D2.11 Post-Doppler Blanking

This Dialogue (Figure D-16) is used to specify post-Doppler (or range-Doppler) blanking parameters which are fixed for a run. It is accessed from the top-level dialogue by selecting "Post Doppler Blanking" at the CTI level. The parameters are similar to those for pre-Doppler blanking. The post-Doppler algorithm and its parameters are described in Document R-7, Appendix A14, "Coherent Sector Blanking".

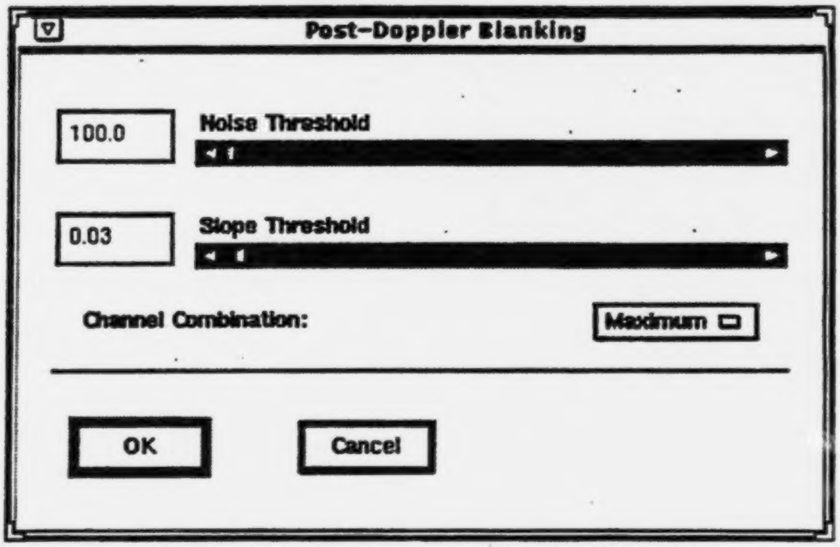
Noise Threshold specifies the noise threshold parameter (Λn) in the post-Doppler blanking algorithm (Document R-7, Equation A.55).

Range: 0 to 14^4
Default: 100

Slope Threshold specifies the slope threshold parameter (Λs) in the post-Doppler blanking algorithm (Document R-7, Equation A.55).

Range: 0.0 to 1.0
Default: 0.03

Channel Combination specifies the channel combination logic if two range-Doppler blankers are enabled in the DSP Configuration. Choices are: Maximum (default), Sum.



100.0 Noise Threshold

0.03 Slope Threshold

Channel Combination: Maximum

Figure D-16 Post Doppler Blanking Dialogue

D2.12 NCI

This dialogue (Figure D-17) is used to specify non-coherent integration parameters which are fixed for a run. It is accessed from the top-level dialogue by selecting "NCI" at the CTI level. NCI integrates multiple bursts of one PRF to produce an integrated range-Doppler power matrix which is ready for detection. The NCI algorithm and its parameters are described in Document R-7, Appendix A15.

Integration Algorithm specifies one of two choices of burst integration:

Linear (default);
Ordered Statistic.

Linear performs a linear sum of bursts while ordered statistic performs a sorting by range-Doppler bin.

Target Range Walk Compensation (TRWC) enables/disables the target range walk component of SA/TRWC range resampling. This corrects for the target velocity component of range walk burst-to-burst in one NCI. Choices are : On (default), Off.

Sampling Alignment (SA) enables/disables the sampling alignment component of SA/TRWC range resampling. This corrects for the fractional range bin offset that occurs between bursts in one NCI. Choices are: On (default), Off.

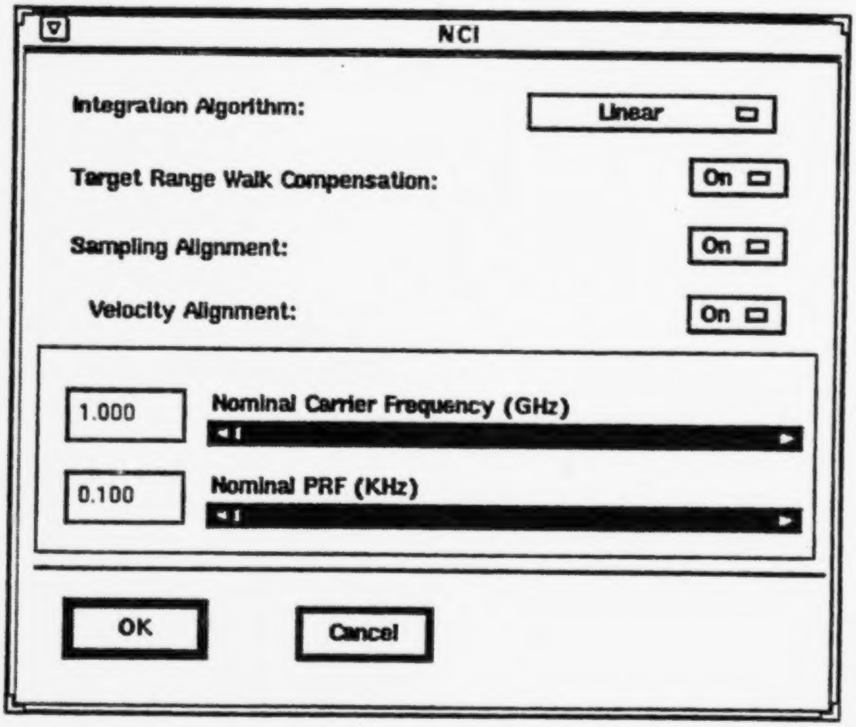
Velocity Alignment (VA) enables/disables the velocity alignment function which resamples the burst in Doppler to normalize to the selected nominal carrier frequency and nominal PRF. Choices are: On (default), Off.

Nominal Carrier Frequency specifies the nominal RF carrier frequency used in velocity alignment. This parameter is enabled only if velocity alignment is "On".

Range of Values:	1.0 to 2.0 GHz (L-band selected) 2.0 to 4.0 GHz (S-band selected)
Default:	Minimum RF Frequency for the run (selected) in Satellite/Radar definition).

Nominal PRF specifies the nominal PRF used in velocity alignment, and is enabled only if velocity alignment is "On".

Range of Values:	0.1 to 100.0 kHz
Default:	Maximum PRF for the run (selected in Satellite/Radar definition).



NCI

Integration Algorithm: Linear

Target Range Walk Compensation: On

Sampling Alignment: On

Velocity Alignment: On

Nominal Carrier Frequency (GHz): 1.000

Nominal PRF (KHz): 0.100

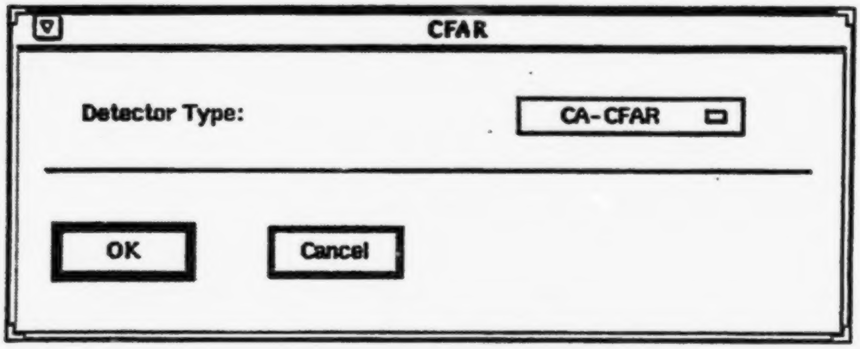
Figure D-17 NCI Dialogue

D2.13 CFAR

This dialogue (Figure D-18) is used to specify CFAR detection parameters which are fixed for the run. This dialogue is accessed from the top-level dialogue by selecting "CFAR" at the CTI level.

Detector Type specifies the type of threshold calculation used in the detection thresholding function (Document R-7, Appendix A16). Choices are:

CA-CFAR	Default choice. Performs cell averaging CFAR detection. Threshold is computed from the average value of samples in the reference window (less guard region).
DS-CFAR	Performs ordered-statistic CFAR detection. Threshold is computed from an ordered ranking of window samples. OS Rank is set at the dwell level.
Fixed	Performs fixed threshold detection. Threshold is a fixed value computed from the probability of false alarm and total noise power in the signal.


CFAR

Detector Type: CA-CFAR

Figure D-18 CFAR Dialogue

D2.14 RAR

This dialogue (Figure D-19) was implemented for any RAR parameters which are fixed for the run. It is accessed from the top-level dialogue by selecting "RAR" at the CTI level. Since RAR was moved out of the DSP and is now performed in PVWare, there are no RAR parameters which are selected at the run or CTI level.

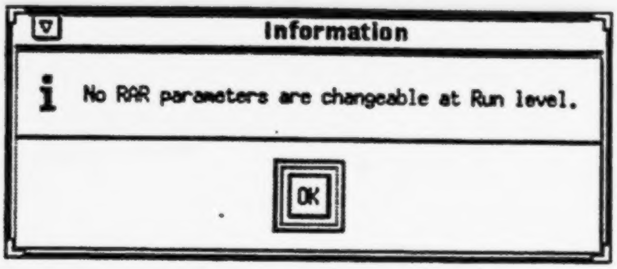

No RAR parameters are changeable at Run level.

Figure D-19 RAR Dialogue

D2.15 RSP Data Capture Options

This dialogue (Figure D-20) is used to select RSP intermediate results for capture during a run. It is accessed from the top-level dialogue through the "RSP Data Capture" button at the CTI level.

Similar to the ESP data capture, the RSP data capture options allow selection of channels where multiple signal channels are processed. Toggle buttons or a selector bar provides the choices of data capture for a run. All RSP products default to "Off" or are captured.

Capture Input Data allows selection of input channels to the RSP for capture to a maximum of 3 channels. The signals on these channels depend on the combination of main phase centres or formed beams, and blankers (if any post-Doppler is enabled). RSP input data capture is performed after PC Doppler augmentation. If it is enabled, the number of Doppler bins will be greater than the Doppler FFT length. Due to memory limitations in the RSP IOPs, this intermediate result is very slow in comparison to other RSP intermediate results, and should only be enabled if absolutely necessary.

Capture Post-PC Data allows selection of channels after pulse compression. The channels correspond to those inputs received from the ESP, but depending on the choices of pulse Doppler, DPCA and blanking, not all Doppler velocity bins are compressed. Only those used in downstream processing will be pulse compressed.

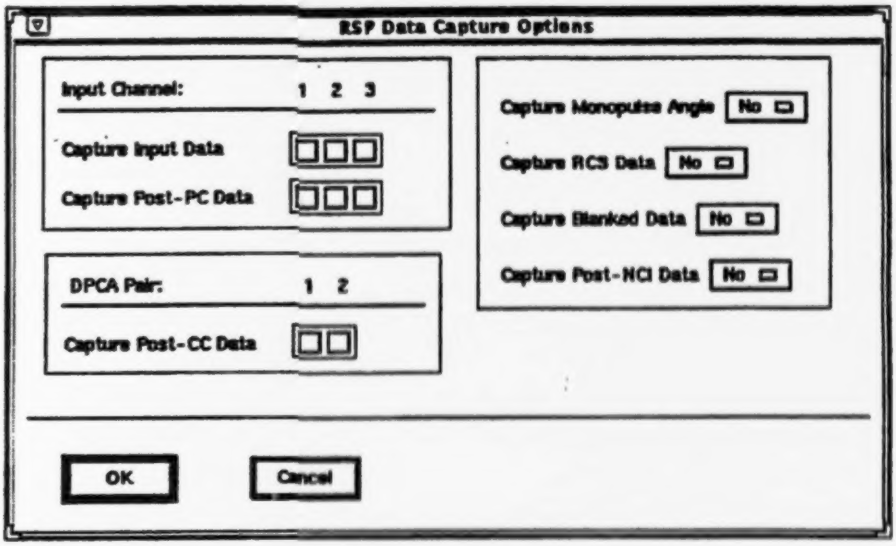
Capture Post-CC Data enables capture of the output signals from ASAR DPCA. DPCA Pair 1 corresponds to the first pair (e.g., leading/middle) phase centres combined in ASAR. If monopulse and ASAR are on, DPCA Pair 2 corresponds to the second phase centre pair (middle/trailing) combined by ASAR, otherwise DPCA Pair 2 is not available for selection.

Capture Monopulse Angle enables capture of the monopulse angle matrix for each burst. This selection is available only if monopulse processing is enabled in the DSP Configuration dialogue.

Capture RCS Data enables capture of the range-Doppler bursts after magnitude-squared RCS detection. A single choice of "On/Off" is provided - multiple RCS channels (if post-Doppler blankers are selected) are captured together and are not individually selectable.

Capture Blanked Data enables capture of the range-Doppler bursts after post-Doppler or range-Doppler blanking. Only one channel of range-Doppler signal is present at this stage for all DSP configurations.

Capture Post-NCI Data enables capture of the integrated range-Doppler matrix after NCI. There is one channel of signal present at this stage for all DSP configurations.



Capture Monopulse Angle: No
Capture RCS Data: No
Capture Blanked Data: No
Capture Post-NCI Data: No

Figure D-20 RSP Data Capture Options Dialogue

D2.16 RSP Products

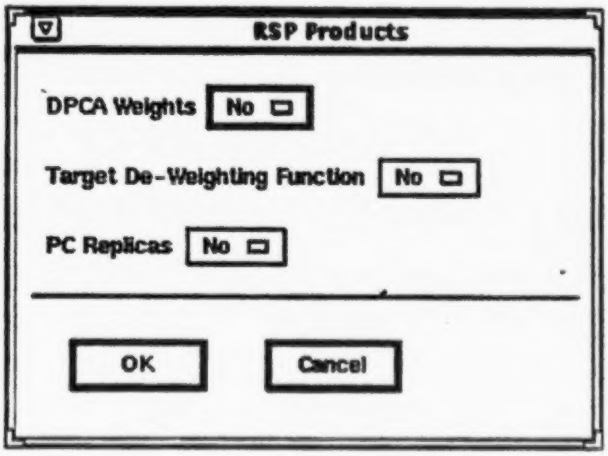
This dialogue (Figure D-21) is used to select RSP equation products for capture during a run. It is accessed from the top-level dialogue through the "RSP Products" button.

Note: *In SPD version 4.1 (November 1994), the capture of DPCA weights and target deweighting coefficients has not been implemented in the RSP software.*

DPCA Weights enables/disables capture of ASAR DPCA weights that are computed for each velocity bin in each burst.

Target Deweighting Function enables/disables capture of ASAR DPCA deweighting coefficients. A vector of deweighting coefficients is computed for the range gates used to compute ASAR DPCA weights in each velocity bin, for each burst.

PC Replicas enables/disables capture of frequency domain pulse compression replicas, computed once per dwell. If Doppler compensated replicas is enabled, there are 11 vectors per dwell, otherwise there is just one per dwell.



DPCA Weights: No

Target De-Weighting Function: No

PC Replicas: No

Figure D-21 RSP Products Dialogue

D2.17 Data Reduction Options

This dialogue box is used to select data reduction options for all DSP intermediate results. It is accessed from the top-level dialogue by selecting "Data Reduction Options" at the CTI level.

Magnitude Squared enables/disables conversion of complex intermediate results to squared magnitude. This affects all ESP signals and RSP signals up to the RCS stage (excluding only RCS data, blanked data and post-NCI data). Default is "No" (complex values are not reduced).

Decimation performs subsampling of captured data to reduce the size of intermediate result files generated. There are four "dimensions": time, Doppler, augmented Doppler and range, but only two are applicable to a particular intermediate result type. All ESP signals up to pulse Doppler and decimated in time (radar pulses) and range samples. After pulse Doppler, the signals are decimated in range-Doppler. In the RSP, Doppler augmentation may be enabled in pulse compression or NCI. If PC Doppler augmentation is enabled, then range/augmented-Doppler is applicable to all RSP products (including RSP input data since it is augmented when written to TPM). If NCI Doppler augmentation is enabled, then range/Doppler decimation is applied to all products except post-NCI, and range/augmented-Doppler is applicable to post NCI data. For further details on decimation as it applies to specific intermediate results, see "Data Capture and Reduction Options" in Sections 3.2.1.7.1 to 3.2.1.7.23, Document R-9.

The decimation parameters "start", "stop" and "step" all use the same sense in decimation. "Start" indicates the first sample captured, starting with "1" indicating the first sample in the data (many internal matrices are indexed starting from zero).

"Stop" specifies the last sample captured. If the stop value exceeds the number of samples in a particular signal, then the intermediate result ends at the last valid sample.

"Step" specifies an increment value. "1" captures all samples, "2" takes every second sample and so on. A step value greater than one produces crude subsampling without any filtering.

Fixed ranges and defaults are implemented for all decimation parameters, and are described below. Defaults are set to capture all samples.

Time Decimation specifies decimation in the radar pulse dimension and applies to all signals prior to pulse Doppler.

	Range	**Default**
Start:	1 - 1024	1
Stop:	1 - 1024	1024
Step:	1 - 1023	1

Doppler Decimation specifies decimation in the Doppler dimension after the pulse Doppler FFT in the ESP.

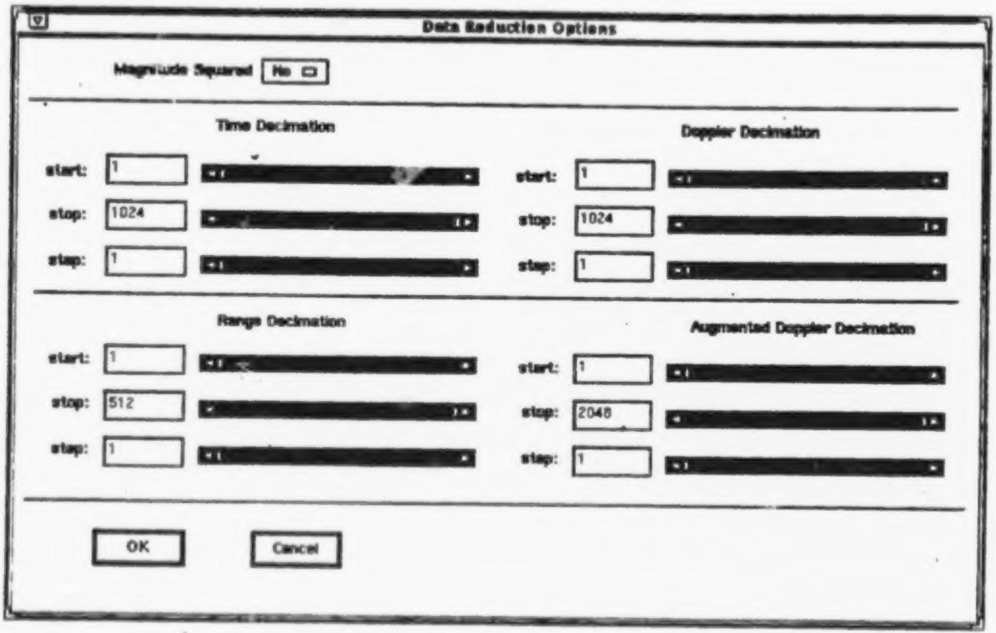
	Range	**Default**
Start:	1 - 1024	1
Stop:	1 - 1024	1024
Step:	1 - 1023	1

Range Decimation specifies decimation in the range dimension (samples in one PRI).

	Range	**Default**
Start:	1 - 512	1
Stop:	1 - 512	512
Step:	1 - 512	1

Augmented Doppler Decimation specifies decimation in Doppler after PC or NCI augmentation in the RSP. Augmenting can double the number of velocity bins to a maximum of 2048 bins. The exact number of velocity bins after augmentation is computed by the RSP and depends on the Unambiguous PRF.

	Range	**Default**
Start:	1 - 2048	1
Stop:	1 - 2048	2048
Step:	1 - 2047	1



Magnitude Squared: No

Time Decimation
start: 1
stop: 1024
step: 1

Doppler Decimation
start: 1
stop: 1024
step: 1

Range Decimation
start: 1
stop: 512
step: 1

Augmented Doppler Decimation
start: 1
stop: 2048
step: 1

Figure D-22 Data Reduction Options Dialogue

D3. DWELL LEVEL

The following groups of Simulation Run parameters are changeable at the dwell level:

- Pulse Doppler;
- ASAR DPCA;
- CFAR;
- RAR.

In each dialogue box, **Dwell ID** indicates the dwell number counting from 1 upward.

D3.1 Dwell Level Pulse Doppler

This dialogue box is used to specify pulse Doppler parameters changeable at each dwell interval. It is accessed from the top-level dialogue by selecting "Pulse Doppler" at the dwell level. For pulse Doppler algorithm details, refer to Document R-7, Appendix A9.

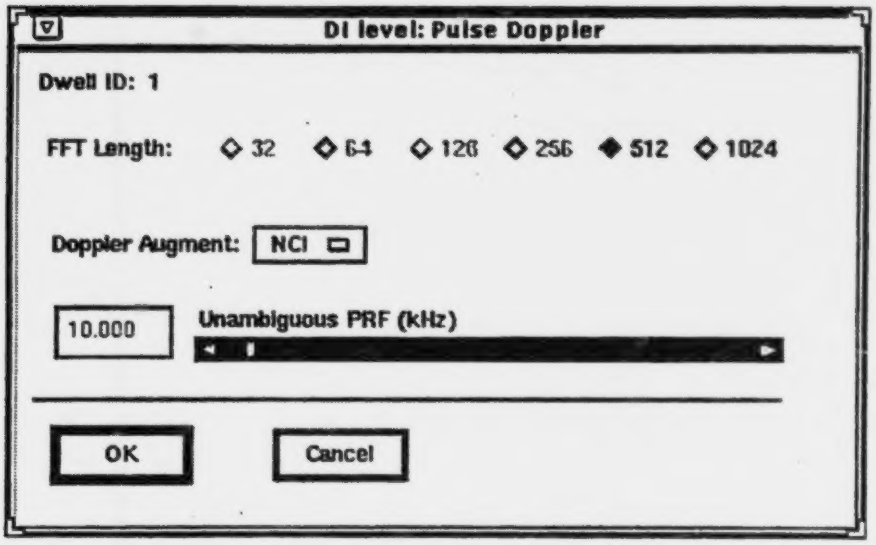
FFT Length specifies the pulse Doppler FFT length and is limited to a minimum power-of-two greater than the maximum number of pulses per NCI in that dwell. Larger values may be selected to generate more velocity bins.

Overall Range:	32 to 1024 in powers of 2
Selection Range:	Power-of-2 greater than number of pulses as above
Default:	First power-of-2 greater than the number of pulses/NCI.

Doppler Augment specifies the choice of Doppler augmentation as: None, PC, NCI. "None" turns off Doppler augmentation and the Unambiguous PRF selection is not applicable. "PC" selects augmentation before pulse compression, and "NCI" selects augmentation before non-coherent integration.

Unambiguous PRF is used to specify the Doppler Frequency to which the input PRF is augmented. Selection is enabled if PC or NCI Doppler augment is selected, otherwise this parameter is not applicable.

Range:	0.2 to 200.0 kHz
Default:	20.0 kHz (RRA) 10.0 kHz (CFA)



DI level: Pulse Doppler

Dwell ID: 1

FFT Length: ◇ 32 ◇ 64 ◇ 128 ◇ 256 ◆ 512 ◇ 1024

Doppler Augment: NCI

10.000 Unambiguous PRF (kHz)

Figure D-23 DI Level: Pulse Doppler Dialogue

D3.2 Dwell Level ASAR DPCA

This dialogue box is used to specify ASAR DPCA processing parameters changeable at each dwell interval. It is accessed from the top-level dialogue by selecting "ASAR DPCA" at the Dwell Level. For further details on ASAR DPCA algorithms, refer to Document R-7, Appendix A11.

Number of DPCA Doppler Bins specifies the number of Doppler bins processed by ASAR DPCA (N_{dpca}). If this is less than the total number of Doppler bins (equal to the pulse Doppler FFT size, plus any bins that are added if PC Doppler augmentation enabled), then the remaining bins are processed as conventional pulse Doppler. The DPCA bins are selected symmetric about zero Doppler, (positive and negative velocities) with the centre bin at DC. Hence an odd number of DPCA bins is always specified.

Range: 1 to 1023 (odd integer)
Default: 127 (fixed).

The number of DPCA bins is normally optimized by user to cover the clutter spectrum which typically spans 10% to 30% of the total Doppler bins.

Number of Range Gates to Compute Weights specifies the number of range gates selected in each Doppler bin to compute ASAR DPCA weights.

Range: 1 to 512
Default: 20 (fixed).

This number affects the accuracy of the DPCA weights and trades off computational requirements of the cross-products needed in target deweighting (Document R-7, Equation A47). The default of 20 is considered sufficient for most configurations. The DSP software will only use valid range gates if the number exceeds the range line size (number of samples per PRI).

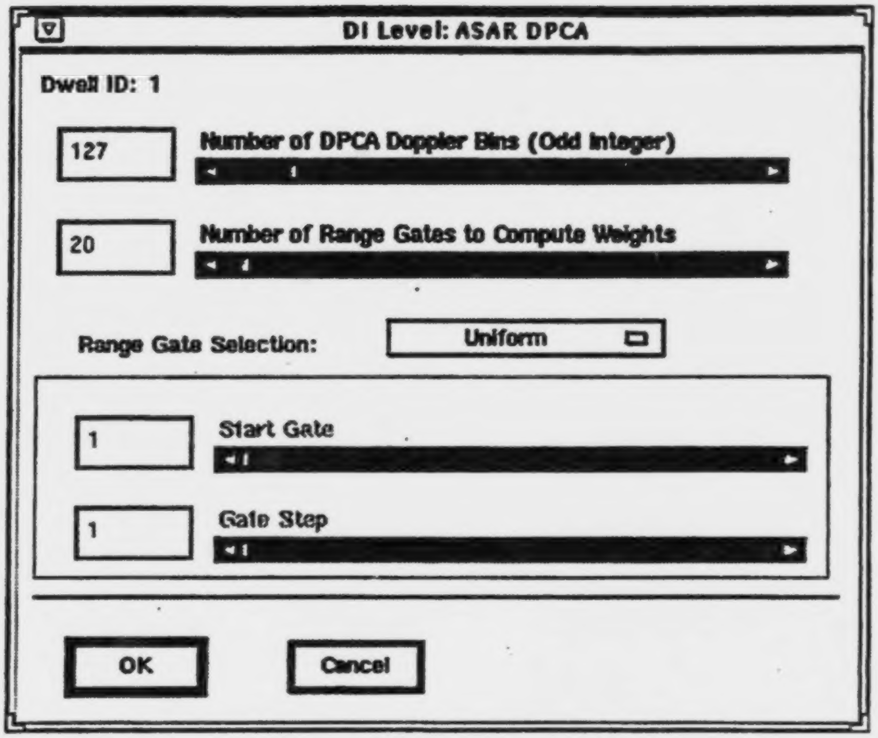
Range Gate Selection specifies one of two choices of range gate selection for ASAR DPCA target deweighting. Choices are: Uniform or Start-Step. "Uniform" spreads the selection of range gates to compute weights as evenly as possible across all range gates. "Start-Step" enables the following two parameters to specify the starting gate and step value.

Start Gate specifies the starting range gate counting from "1" as the first range gate (zero range) for weight calculation. This is enabled only if "start-step" range gate selection is enabled.

Range: 1 to 512
Default: 1

Gate Step specifies an increment between range gates for weight calculation. This is also enabled only if "Start-Step" is enabled.

Range: 1 to 511
Default: 1



Dwell ID: 1

127 Number of DPCA Doppler Bins (Odd Integer)

20 Number of Range Gates to Compute Weights

1 Start Gate

1 Gate Step

Figure D-24 DI Level ASAR DPCA

D3.3 Dwell Level CFAR

This dialogue box is used to specify CFAR threshold detection parameters changeable at each dwell interval. It is accessed from the top-level dialogue by selecting "CFAR" at the dwell level. These CFAR parameters are enabled only if CA or OS-CFAR is selected at the CTI level. If Fixed Threshold detection is selected, only the probability of false alarm is active in this dialogue. For details on the CFAR parameters, see Document R-7, Appendix A16.

Doppler Width specifies the size of the reference window in Doppler bins (L_v).

Range:	1 to 2048 (fixed)
Default:	1 (RRA) 35 (CFA)

Range Width specifies the size of the reference window in range samples (L_r).

Range:	1 to 512 (fixed)
Default:	35 (RRA) 1 (CFA)

Notes on Doppler and Range Width:

1. Width may be even or odd, however, odd integers guarantee the reference window is symmetric about the test cell (in the centre).
2. Doppler width and range width may not both be one, this will cause a validation error.
3. If the width exceeds the number of samples available in either dimension, CFAR will just assume all samples in that dimension are used.

Guard Doppler Width specifies the number of guard cells in Doppler (G_v) within the reference window (G_v), and must be less than or equal to the reference window Doppler width to be valid.

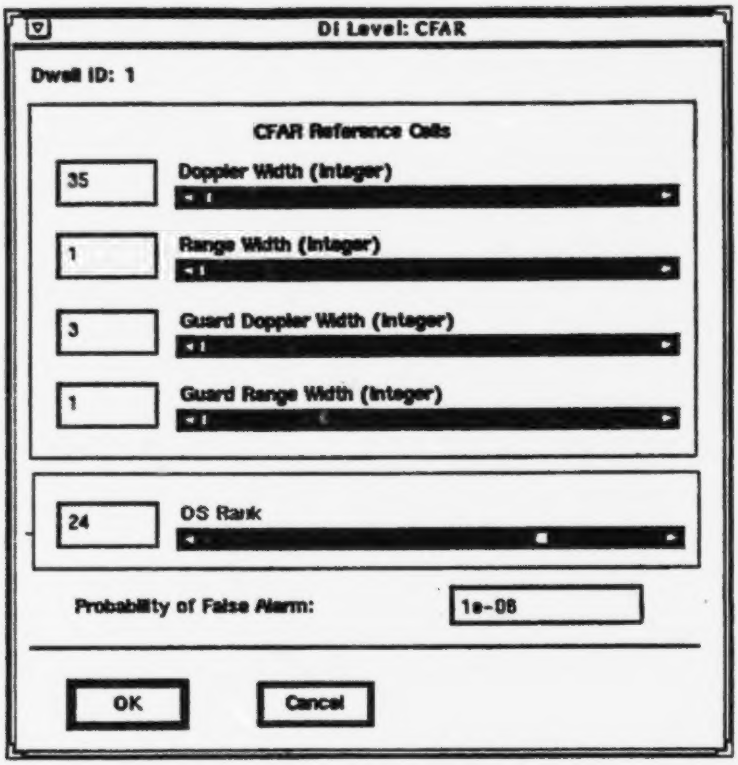
Range:	0 to 2048 (fixed)
Default:	1 (RRA) 3 (CFA)

Guard Range Width specifies the number of guard cells in range (G_n) within the reference window, and must be less than or equal to the reference window range width to be valid.

Range:	0 to 512 (fixed)
Default:	3 (RRA) 1 (CFA)

Notes on Guard Region:

1. If $G_r=G_v=0$ or $G_r=1, G_v=0$ or $G_r=0, G_v=1$
   then no guard region is used and the test cell is included in the reference window.
2. G_v and G_r may not both equal the size of the reference window.



Dwell ID: 1

35 Doppler Width (Integer)
1 Range Width (Integer)
3 Guard Doppler Width (Integer)
1 Guard Range Width (Integer)
24 OS Rank
Probability of False Alarm: 1e-08

Figure D-25 DI Level: CFAR Dialogue

D3.4 Dwell Level RAR

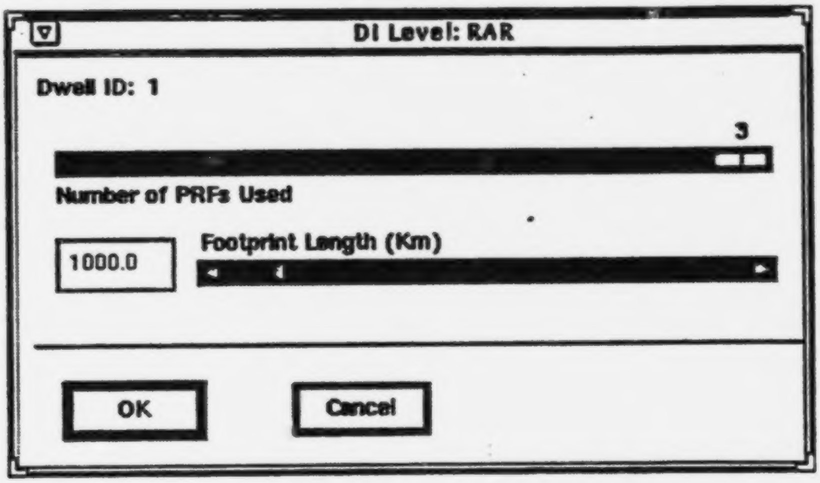
This dialogue box is used to specify range ambiguity resolution parameters changeable at each dwell interval. It is accessed from the top-level dialogue by selecting "RAR" at the dwell level. RAR is now implemented in PVWave and is executed after a simulation run is completed. The only dwell level RAR parameter used from this dialogue is the "Footprint Length" parameter. For further details on RAR parameters, refer to Document R-7, Appendix A17.

Number of PRFs used was originally designed to specify the number of NCIs used ("M") in M of N RAR, however, the "M" value is now entered in the separate PVWave GUI used to run RAR – See Appendix G for details.

Range:	1 to Number of NCIs in dwell
Default:	Number of NCIs in dwell.

Footprint Length specifies the Footprint Length (FPL) parameter used in the algorithm to reject detections outside the expected main beam footprint.

Range:	1 to 10,000 km (fixed)
Default:	1000 km (fixed)



DI Level: RAR

Dwell ID: 1

Number of PRFs Used: 3

Footprint Length (Km): 1000.0

Figure D-26 DI Level: RAR Dialogue

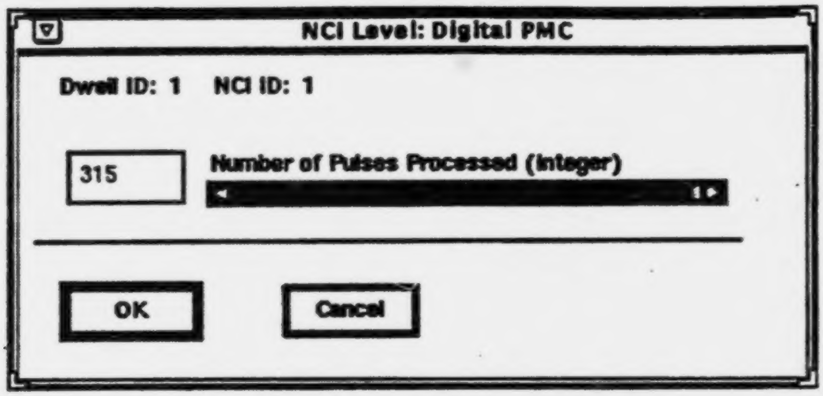
D4. NCI LEVEL

D4.1 NCI Level Digital PMC

This dialogue is used to specify the number of pulses processed in each CPI in this NCI N_{pp} (Document R-7, Appendix A-3). It is accessed by selecting "Number of Pulses Processed" at the NCI level.

Range:	32 to Number of Pulses Transmitted (per CPI)
Default:	Number of Pulses Transmitted

The number of pulses transmitted is set by the "Pulses per CPI" parameter in the Satellite/Radar Definition — NCI Interval Definition.



NCI Level: Digital PMC

Dwell ID: 1 NCI ID: 1

315 Number of Pulses Processed (Integer)

Figure D-27 NCI Level: Digital PMC

D4.2 NCI Level: Non-Coherent Integration

This dialogue is used to specify NCI processing parameters changeable at each NCI. It is accessed from the top-level dialogue by selecting "NCI" under RSP Processing at the NCI level. For further details on the NCI parameters, refer to Document R-7, Appendix A15.

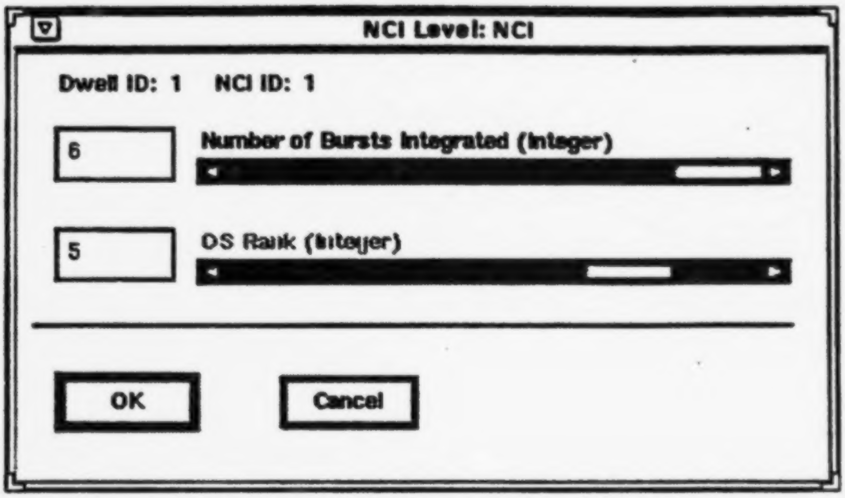
Number of Bursts Integrated specifies the number of CPIs integrated out of the total number in the non-coherent interval. If this number is fewer than the number of CPIs transmitted, then the first CPIs are integrated and the last ones ignored.

Range:	1 to Number of CPIs transmitted
Default:	Number of CPIs transmitted (set in Satellite/Radar Definition).

OS Rank specifies the OS-NCI rank parameter (OS_rank) if OS_rank integration is enabled. A rank value equal to the number of CPIs transmitted (in this NCI) means ordered statistic takes the largest value. A rank value of 1 means take the lowest value.

Range:	1 to Number of CPIs transmitted
Default	Number of Bursts Integrated -1.

If the number of bursts integrated is reduced (causing the OS rank to become out-of-range), the dialogue will prompt the user to reset the OS rank to a new default value.



NCI Level: NCI

Dwell ID: 1 NCI ID: 1

6 Number of Bursts Integrated (Integer)

5 DS Rank (Integer)

Figure D-28 NCI Level: NCI Dialogue

D5. CPI LEVEL

There are no Simulation Run parameters changeable at the CPI level other than intermediate data capture interval selection.

Capture CPI Enable is used to enable capture of intermediate results for this CPI, and defaults to "On" (button "filled" or darkened). Clicking the button toggles it "Off", meaning that the intermediate results enabled (in ESP Data Capture and RSP Data Capture dialogues) will not be captured for this CPI.

Enable All sets all Capture CPI Enable buttons to the "On" or enabled state.

Disable All sets all Capture CPI Enable buttons to the "Off" or disabled state.

Note that the capture of products at the CPI level is not affected by the states of Capture NCI or Capture Dwell enable buttons.

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APPENDIX E

MONITOR/CONTROL SIMULATION HMIs

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APPENDIX E

MONITORING/CONTROL SIGNAL GENERATION

E1.1 Top Level Dialogue

The Monitor/Control Signal Generation dialogue is used to start-up, monitor, and control the generation of radar signal data. Figure E-1 shows the top-level dialogue forming this HMI. This dialogue is activated by starting the Signal Generation HMI either by clicking on its iconic representation in the Unix FileManager, or by typing the command *siggen*.

The Monitor/Control Signal Generation dialogue is split into two main areas:

- Execution Definition area;
- Validation Error Log area.

The execution definition area consists of the user-entered parameters down to below "Execute" and "Exit". This is separated from the Validation Error log area by a sash which can be dragged up or down with the small square box near the right side of the dialogue. This can be used to enlarge the Validation Message log area without increasing the overall size of the dialogue. The entire dialogue box can also be enlarged or reduced by dragging the corners of the window.

In order to generate simulated radar signal data, the user must define:

1. Input filenames of the Satellite/Radar and Environment definitions;
2. Output directory names for signal data and intermediate results;
3. A simulation run identifier.

Filenames and directories must be selected through a File Selection Dialogue which is activated by pressing the small button immediately left of each filename display field.

Direct editing of the text field is not supported. The filenames and directories may be selected in any order, but all must be defined before executing signal generation.

Sat/Rad Definition is used to select the filename containing the Satellite/Radar Definition file (default filename: **.pa.sar_def*). Click on the small button to open the file selection dialogue and select the desired directory and filename. When the HMI is started, the directory path defaults that set in the Unix environment variable *PARM_DIR*.

Environment Definition is used to select the filename containing the Environment Definition file (default filename: **.pa.env_def*). Select the desired file as above. The default directory for the environment definition also defaults to value of the Unix environment variable *PARM_DIR*.

SRSD File Directory is used to specify the directory in which the simulated radar signal data file will be written by signal generation. The default directory for the output signal is the value of the Unix environment variable *SRSD_DIR*. The signal data filename is *<genid>.sg.srsd*, where *<genid>* is the generation identifier below.

Interm. Results Dir is used to specify the directory in which RSS intermediate results will be written. The default directory is the value of the Unix environment variable *PROD_DIR*.

Generation Identifier is used to define an alphanumeric < *genid*> which is used as a prefix to all files created by this signal generation run. The text field is edited directly.

Execute is used to start signal generation activity after the files and directories above are defined. The SPD begins signal generation by validating the input definitions. If any validation errors are detected, warning messages will be displayed in the Validation Message Log area and a summary status message will also be displayed in the Status Message Area immediately right of the Exit button. If the errors are non-fatal, the user will be prompted to continue with the signal generation process. Signal generation can be aborted at this point. Once signal generation calculations begin, the Progress Status pop-up dialogue is displayed (see below) and indicates the generation progress until complete.

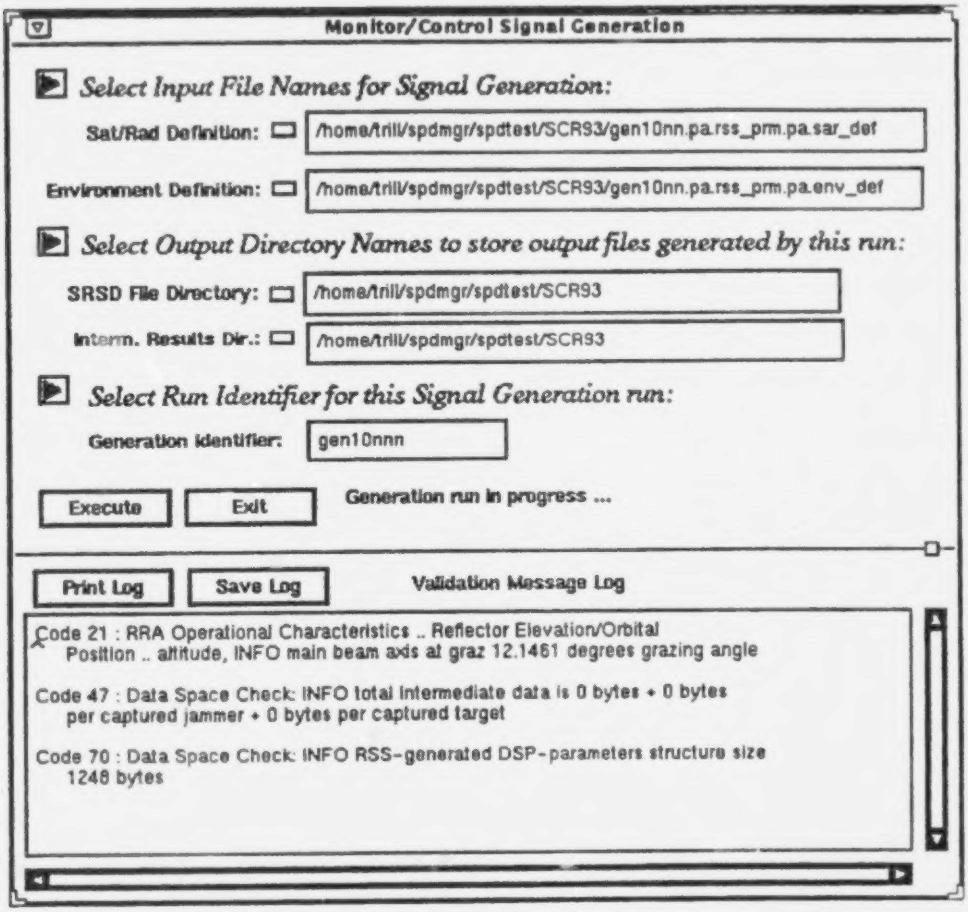
Exit is used to quit from the top-level Signal Generation dialogue. This will first prompt the user to confirm the exit operation. Pressing "OK" confirms the exit operation, and the dialogue window is terminated. Quitting the window from the OpenWindows menu bar (activated by placing the mouse pointer at the top of the window and pressing the right mouse button, and selecting "Quit") has the same effect.

Print Log is used to print the validation message log directly to the printer (*ps_sbr*).

Save Log is used to save the validation message log to a file. The user is prompted for the name of a file. Default directory is defined by the Unix environment variable *LOGS_DIR*.

Status Message Area is an unmarked area immediately to the right of the "Exit" button and is used to display a number of status messages related to the current status of signal generation. For a list of these status messages, refer to Appendix F, CGEH - Part 1: Status messages displayed on top-level dialogue.

Validation Message Log is the scrolled area at the bottom of the dialogue and is used to display detailed informational, warning and error messages reported during signal generation. This log may be printed or saved to a file using the Print Log and Save Log buttons.



Select Input File Names for Signal Generation:

Sat/Rad Definition: /home/trill/spdmgr/spdtest/SCR93/gen10nn.pa.rss_prm.pa.sar_def

Environment Definition: /home/trill/spdmgr/spdtest/SCR93/gen10nn.pa.rss_prm.pa.env_def

Select Output Directory Names to store output files generated by this run:

SRSD File Directory: /home/trill/spdmgr/spdtest/SCR93

Interm. Results Dir.: /home/trill/spdmgr/spdtest/SCR93

Select Run Identifier for this Signal Generation run:

Generation Identifier: gen10nnn

Generation run in progress ...

```
Code 21 : RRA Operational Characteristics .. Reflector Elevation/Orbital
    Position .. altitude, INFO main beam axis at graz 12.1461 degrees grazing angle

Code 47 : Data Space Check: INFO total intermediate data is 0 bytes + 0 bytes
    per captured jammer + 0 bytes per captured target

Code 70 : Data Space Check: INFO RSS-generated DSP-parameters structure size
    1248 bytes
```

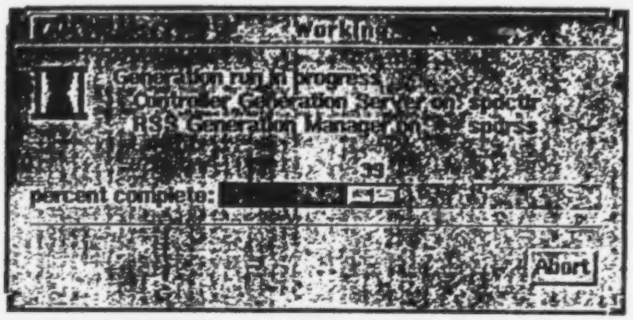
Figure E-1 Monitor/Control Signal Generation Dialogue

E1.2 Progress Status Dialogue

This pop-up dialogue is displayed while signal generation activity is in progress, and is removed when signal generation is completed or aborted. While this dialogue box is displayed, inputs to the top-level Monitor/Control Signal Generation dialogue are blocked.

The **percent complete** widget indicates an estimated percentage complete of signal generation (0 - 100%). The percentage complete is updated for each iso-Doppler bin in each CPI, and gives an *approximate* indication of the time remaining in signal generation. If bursts are of similar sizes, progress through CPIs is nearly linear, however, computation time through isoDops in each CPI varies depending on the geometry, and may not be linear.

Abort is used to abort signal generation activity before it completes normally. The user is prompted with a confirmation dialogue box before signal generation is halted.


Generation run in progress
Controller Generation Server on spdctr
RSS Generation Manager on [illegible] spdrss

percent complete: 39

Figure E-2 Progress Status Dialogue

E1.3 Notes on Signal Generation

E1.3.1 Signal Generation Time and Additional Monitoring

Due to the complexity of the radar signal generation algorithms, signal generation time with any clutter defined (Background Clutter enabled, or clutter patch defined), can be very long, taking many hours to complete. Additional information on the progress of signal generation can be obtained by "tailing" the signal generation log file which is normally written to disk file. The messages written to this log *do not* appear in the status or validation message area of the HMI. To tail the generation file, open a Unix command tool or Xterm window, and type the command *genlog*. During signal generation a number of informational messages on the progress through the signal generation models are produced.

E1.3.2 Common Non-Fatal Validation Warnings

1. **Range Eclipsing**

If a range eclipsing waveform was defined in the Satellite/Radar definition, the warning message: "... transmitting CPI xxx while receiving CPI yyy..." will be generated for each transmitted burst that overlaps and eclipses the receive interval for an earlier CPI. These messages will be produced during validation and the HMI will prompt the user whether to continue with errors detected. The warning message indicates the percentage overlap and the duty cycle of the eclipsing. The waveform may overlap some or all of a subsequent CPI, but provided the duty cycle of the pulse is not too great (typical RE waveforms are about 10%) then signal generation can continue.

E2. MONITOR/CONTROL SIMULATION RUN

E2.1 Top Level Dialogue

The Monitor/Control Simulation Run dialogue is used to start-up, monitor and control the playback and processing of radar signal data on the DSP. Figure E-3 shows the top-level dialogue box. It is activated by starting the Simulation Run HMI either from its icon, or by typing the command *simrun* at the Unix prompt.

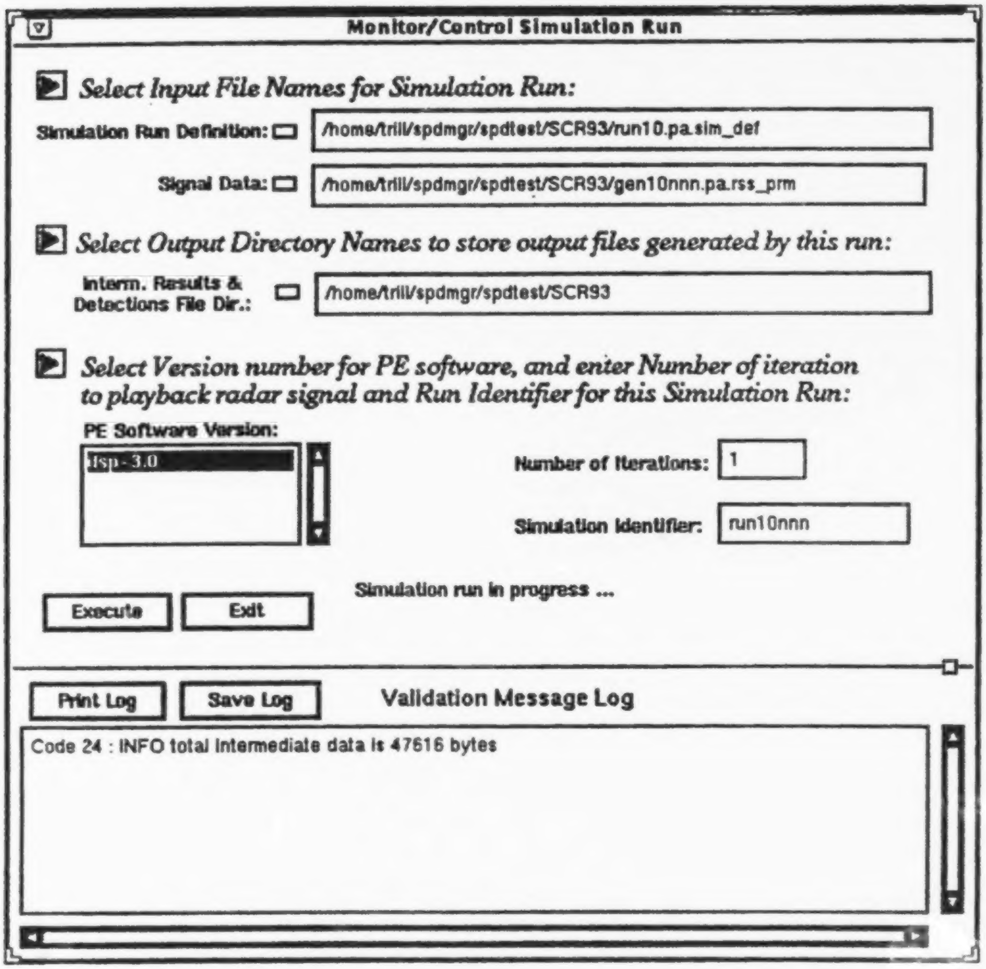
Similar to the Signal Generation dialogue, the Simulation Run dialogue is divided into an execution definition area and a validation error log area. The sash on the right side can be dragged up or down to change the relative size of each area, and the overall window size can be changed to increase or reduce the message area.

In order to process a previously saved radar signal data file on the DSP, the user must define:

1. Input filenames of the Simulation Run definition and Signal Data filename;
2. Output directory name for detections and intermediate results;
3. PE Software version, Number of Iterations and run identifier.

The filenames and directories are selected through File Selection dialogues which are activated by selecting the small button immediately left of each filename or directory display field. The following are defined:

Simulation Run Definition is used to select the filename containing the Simulation Run definition file (default filename **.pa.sim_def*). To ensure that the run definition is consistent with the signal data file being selected, the Simulation Run definition should be one that was defined with the same signal data about to be processed. See Appendix D, section D1.6 for discussion on creating a simulation run definition for a particular signal data file. When the HMI is started, the directory path defaults to the value of the Unix environment variable *PARM_DIR*.



Select Input File Names for Simulation Run:

Simulation Run Definition: /home/trill/spdmgr/spdtest/SCR93/run10.pa.sim_def

Signal Data: /home/trill/spdmgr/spdtest/SCR93/gen10nnn.pa.rss_prm

Select Output Directory Names to store output files generated by this run:

Interm. Results & Detections File Dir.: /home/trill/spdmgr/spdtest/SCR93

Select Version number for PE software, and enter Number of iteration to playback radar signal and Run Identifier for this Simulation Run:

PE Software Version: dsp-3.0

Number of Iterations: 1

Simulation Identifier: run10nnn

Simulation run in progress ...

Validation Message Log

```
Code 24 : INFO total intermediate data is 47616 bytes
```

Figure E-3 Monitor/Control Simulation Run Dialogue

Signal Data is used to select the radar signal data file to be loaded and played back through the DSP. This file is selected similar to the other input files. The Radar Signal Data (SRSD) is specified in terms of its associated RSS parameters file, hence the default filename has the form *<genid>.pa.rss_prm*. This associated RSS parameter file contains pointers to the following files:

a) Signal Data file:	*<genid>.sg.srsd*
b) Associated Satellite/Radar definition:	*<genid>.pa.rss_prm.pa.sar_def*
c) Associated environment definition:	*<genid>.pa.rss_prm.pa.env_def*

which are necessary for proper validation of the run definition. The "unassociated" SRSD file may not be entered directly in this field. The RSS parameter file may point to a different directory for (a)-(c), however, if the file cannot be found in that directory, the software will try to find the filename in the same directory as the selected *<genid>.pa.rss_prm* file.

Interm. Results & Detections Dir. specifies the output directory for all DSP intermediate results and detection data generated in the run. The directory may be changed by pressing the file select button and choosing the new directory in the File Select dialogue. The default directory for these data is defined by the Unix environment variable *PROD_DIR*.

PE Software Version is used to specify the version of processing element software loaded into the PEs for signal processing. This affects the software that runs on the VASP GSPs and IOPs only, and not the Executive CPUs. This feature can be used to load customized versions of PE software.

The version names displayed in this selection are derived from the subdirectories under *$SPDMGRBIN* whose names contain the letters "sp". The DSP version names follow the naming convention of "dsp-x.x" where x.x is a specific numerical version identifier. The filter "sp" was chosen so that separate ESP and RSP versions used in testing were also displayed, but for SPD use, these are loaded together. Also see Appendix I5 "Creating a New Version of DSP Software".

Number of Iterations is used to specify the number of iterations of the entire signal data file through the DSP. Since most simulated waveforms only represent several seconds of real-time, repeated iterations can be used to demonstrate sustained DSP operation and to provide a sustained indication of the fraction of real-time being achieved.

Range of Values:	1 to 2^{31}-1
Default:	1

If a large iteration count is selected, "Abort" must be used to stop processing prematurely.

Simulation Identifier is used to define an alphanumeric simulation run identifier (*runid*) which is used to prefix all files created by the simulation run. This field is edited directly.

Execute is used to start simulation run activity after all the input files and directories are defined. When the simulation run is started, the SPD begins by validating the input files.

If any validation errors are detected, messages will be displayed in the validation message log area. A summary status message will also be displayed in the Status Message Area. If the errors are non-fatal, the user will be prompted to continue with the run. Once the simulation run begins, the Progress Status pop-up dialogue is displayed (see below).

Exit is used to quit from the Simulation Run dialogue. This will first prompt the user to confirm the exit operation before the HMI quits.

Print Log is used to print the validation message log directly to the printer.

Save Log is used to save the validation message log to a user-specified file. The user is prompted for the name of a file. The default directory is defined by the environment variable *LOGS_DIR*..

Status Message Area is an unmarked area immediately to the right of the "Exit" button and is used to display status messages. For a list of all Simulation Run status messages, see Appendix F, CSIH - Part 1: Status messages displayed on top-level dialogue.

Validation Message Log is the scrolled area at the bottom of the dialogue and is used to display simulation run validation messages. The log may be printed or saved to a file using the Print Log and Save Log buttons.

E2.2 Progress Status Dialogue

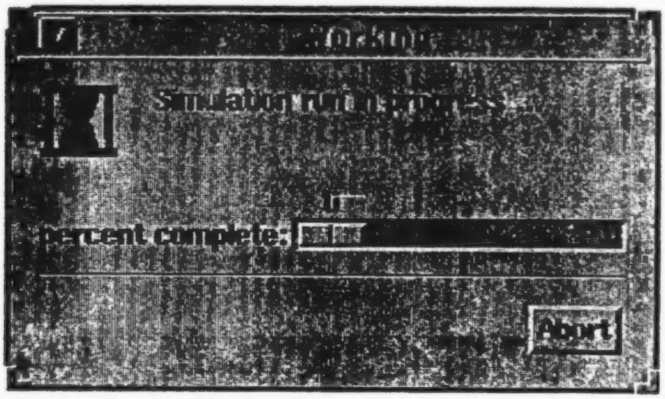
This pop-up dialogue is displayed while Simulation Run activity is in progress, and is removed when the simulation run is completed or aborted. While this dialogue box is displayed, inputs to the top-level Monitor/Control Simulation Run dialogue are blocked.

Real-Time Factor is designed to display a real-time rate factor computed as the ratio of the actual waveform duration to the playback and processing time per iteration. The real-time factor uses a waveform duration parameter, computed in RSS signal generation, and the playback time per iteration, which is measured and uploaded from the RTSG during playback and processing. For example, a waveform which represents 2 seconds of real-time, and is processed in 4 seconds, would be rated as 0.50 real-time. To get an accurate real-time factor, several iterations of the waveform should be used to average out fluctuations in the factor due to buffering and pipeline delays in the DSP.

Note: *In Version 4.1 (Nov. 1994) of the software, the waveform duration parameter is not available, and so the real-time factor is not displayed.*

Percent Complete is similar to that in Signal Generation - this slider widget indicates the percentage of the run completed and gives an approximate indication of progress. The percent complete value is updated for detections received from the DSP for each NCI. The total number of NCIs is known from the total number of NCIs in the waveform and the number of iterations specified. For example, if one iteration of one dwell with 3 NCIs is processed, the slider will be updated to 33, 66 and then to 100% at completion. If the number of iterations, dwells, and NCIs per dwell is increased, the updating intervals become correspondingly finer.

Abort is used to abort simulation run activity before it completes normally. The user is prompted with a confirmation dialogue box before the DSP run is aborted. If "OK" is selected in the confirmation, the Testbed Controller sends an "Abort" command to the ESP and RSP, and it waits for acknowledgements that processing has halted before the Progress Status dialogue box is closed.

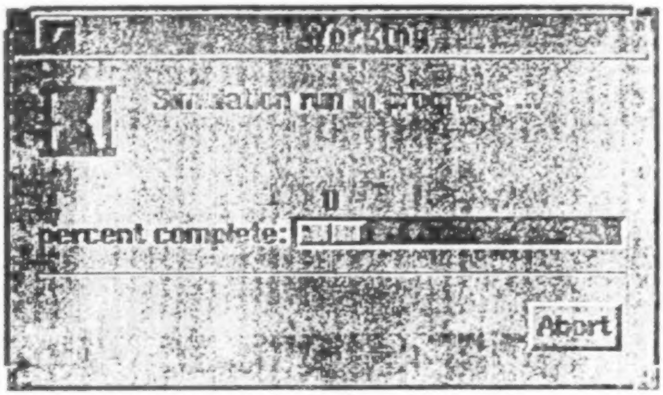


Simulation run in progress...

Figure E-4 Progress Status Dialogue

become correspondingly finer.

Abort is used to abort simulation run activity before it completes normally. The user is prompted with a confirmation dialogue box before the DSP run is aborted. If "OK" is selected in the confirmation, the Testbed Controller sends an "Abort" command to the ESP and RSP, and it waits for acknowledgements that processing has halted before the Progress Status dialogue box is closed.



Simulation run in progress ...

10

percent complete:

Figure E-4 Progress Status Dialogue

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APPENDIX F

SPD ERROR MESSAGES

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APPENDIX F

SPD ERROR MESSAGES

This appendix lists the informational, warning and error messages generated by the SPD. The messages are organized here into the four functional areas:

a)	Radar Signal Simulator	(section F1.)
b)	Testbed Controller	(section F2.)
c)	ECCM Signal Processor	(section F3.)
d)	Radar Signal Processor	(section F4.)

Within each section, the messages are further organized by CSU. All messages can be traced to a unique functional area and CSU by the CSU identifier.

All SPD messages begin with the CSU name or the software function name which follows the convention of *f_<csu_name>_...* Section F5 of this appendix lists a few additional common error codes used in the VASP support software, and may be observed if errors in the PESS drivers are detected in the RSS/RTSG, ESP or RSP.

Table F-1 below can be used to locate a particular CSU within a functional area.

Table F-1 CSUs Organized by Functional Area

RSS	TB CTLR	ESP	RSP
SBIT	CDAT	EESP	PERI
SBMT	CEND	EMAN	RCON
SGEN	CENH	ERSI	RDDH
SPMT	CGET	ERSO	RDET
SRUN	CRAD	ESIG	RINP
SSGM	CRDH	ETBI	RIRH
SUTL	CSDH	EUTL	RMGR
TDIT	CSID	EWVU	RNCI
TIOP	CSIH		RPCP
TRSV	CSIT		VRSP
CSYS	CSYS		
CUIS	CUIS		
CVAL	CVAL		

F1.1 RADAR SIGNAL SIMULATOR MESSAGES

The RSS functional area comprises signal generation CSUs (starting with S..) and signal playback functions in the RTSG (starting with T...). Signal generation may produce general error messages, listed in F1.2 below, and messages specific to particular generation CSUs.

The general format of RSS errors is:

<timestamp> <function> <severity> <message>

where <timestamp> is a time stamp in hh:mm:ss, and for signal generation errors:

<function> =	f_sbit, f_sbmt, f_sgen, f_spmt, f_srun, f_ssgm, f_sutl
<severity> =	INFO, WARN, FATAL
<message> =	Informational messages listed below (sections E1.1 to E1).

For signal playback errors:

<function> =	f_tdit, f_trsv, (EC CPU functions)
TIOP <n>	(n = 0,1,2; identifies input IOPs)

F1.2 General RSS Error Messages:

```
asin returned failure: 110
atan2 returned failure: 108
Beam pointing is invalid: 114
CSPI mathematical function error detected: 115
Denominator of a division is ZERO: 106
f_sgen_matrix_mult returned failure: 113
Inconsistent user-entered geometry for BROADSIDE LOOK(orbit angle): 102
Inconsistent user-entered geometry for EQUATORIAL LOOK(orbit angle): 101
Inconsistent user-entered geometry for GENERAL case(orbit angle): 103
Inconsistent user-entered geometry for NADIR LOOK(orbit angle): 100
Input argument to acos() on CSPI is not in range +- 1: 112
Input argument to asin() on CSPI is not in range +- 1: 111
Invalid index while generating uniform random numbers: 104
Negative argument to square root function: 105
Square root of a negative number or divide by zero: 107
The input argument to acos was not in the range -1 to 1: 109
Unexpected setting of errno flag, errno= %d : 116
```

F1.3 SBIT Errors

Format:

<timestamp> f_sbit_... <severity> <message>

where <message>:

```
allocation memory for antenna database failed, errno = %d: 441
allocation memory for attenuation database failed, errno = %d: 440
allocation memory for cpa index database failed, errno = %d: 445
allocation memory for cpc database failed, errno = %d: 449
allocation memory for cpi database failed, errno = %d: 436
allocation memory for dwell database failed, errno = %d: 438
allocation memory for earth_clutter_database cpa[] failed: 435
allocation memory for grazing database failed, errno = %d: 446
allocation memory for jammmer database failed, errno = %d: 444
allocation memory for nci database failed, errno = %d: 437
allocation memory for noise coeffs database failed, errno = %d: 442
allocation memory for range database failed, errno = %d: 447
allocation memory for rd_map database failed, errno = %d: 454
allocation memory for target database failed, errno = %d: 443
allocation memory for waveform coeffs database failed, errno = %d: 439
Beam centre not on the earth:  400
Burst Initialize (sbit) aborted: 434
close (system call) failed, errno = %d: 408
Could not get anymore shared memory, errno = %d: 433
dealloc memory for antenna pattern database failed, errno = %d: 428
dealloc memory for attennuation database failed, errno = %d: 425
dealloc memory for cpi database failed, errno = %d: 418
dealloc memory for dwell database failed, errno = %d: 420
dealloc memory for earth clullter graz database failed, errno = %d: 458
dealloc memory for earth clullter range database failed, errno = %d: 459
dealloc memory for earth clutter cpa_row_index database failed, errno = %d: 461
dealloc memory for earth clutter cpc database failed, errno = %d: 460
dealloc memory for earth clutter database failed, errno = %d: 426
dealloc memory for earth_clutter cpa database failed, errno = %d: 457
dealloc memory for jammer database failed, errno = %d: 430
dealloc memory for nci database failed, errno = %d: 419
dealloc memory for noise coeffs database failed, errno = %d: 427
dealloc memory for precip database failed, errno = %d: 424
dealloc memory for replica database failed, errno = %d: 422
dealloc memory for shm database failed, errno = %d: 431
dealloc memory for target database failed, errno = %d: 429
dealloc memory for waveform coeffs database failed, errno = %d: 423
dealloc memory for waveform database failed, errno = %d: 421
Disk space is not  available for sgen_ftruncate: 451
Error: Beam pointing lat/lon is outside of Field of View: 411
Error: Beam position cannot be scanned: 413
Error: Beam position is behind RRA antenna: 412
Error: RRA cannot scan to this position: 414
fstat (system call) failed, errno = %d: 450
ftruncate (system call) failed, errno = %d: 409
Index out of range: 463
log2 system call flagged an error, errno = %d: 415
mmap (system call) failed, errno = %d: 406
munmap (system call) failed, errno = %d: 410
open (system call) failed, errno = %d: 404
pow system call flagged an error, errno = %d: 417
range doppler map generates %d isodops: 465
SBIT finished: 432
sbit_ierf_error?: 407
shmat (system call) failed, errno = %d: 403
shmctl (system call) failed, errno = %d:  402
shmget (system call) failed, errno = %d:  401
Size of sparse sequence has exceeded the maximum: 462
sub-aperture is not contained within main aperture: 416
Sub_module #%d, Range swath(irs) = %d, Clutter patch(icp) = %d: 448
System call fopen failed for the external antenna pattern file: 464
The Range Doppler Map routine begins: 455
The Range Doppler Map routine finished: 456
Warning: number of jammer is zero: 453
```

```
Warning: number of target is zero: 452
write (system call) failed, errno = %d: 405
```

Note: %d is a "C" formatting code to print a decimal integer value.

F1.4 SBMT Errors

Format of message:

<timestamp> f_sbmt_... <severity> <message>

where <message>:

```
Aggregate Return calloc() failed:  546
allocation memory for the noise matrix failed, errno = %d: 514
Burst Modelling (sbmt) aborted:  502
Burst rx sample time instances for Discrete calloc() failed: 510
Burst rx sample time instances for Target calloc() failed: 532
Burst tx sample time instances for Discrete calloc() failed: 511
Burst tx sample time instances for Target calloc() failed: 533
CPI output data calloc() failed:  549
Decimated Samples calloc() failed:  547
Derivative Samples calloc() failed:  548
Discrete Return calloc() failed:  527
Discrete Samples calloc() failed:  526
Discrete Sequence Time calloc() failed:  506
Divide by zero:  524
Earth Clutter Generation Begin:  552
Earth Clutter Generation Stop:  553
f_sgen_az_int returned failure:  515
f_sgen_min_elev_iso_err returned failure:  516
IQ Samples calloc() failed:  550
New Sparse Discrete Sequence calloc() failed:  508
New Sparse Target Sequence calloc() failed:  539
Post AD Samples calloc() failed:  551
Rx Weighted Sparse Discrete Sequence calloc() failed:  509
Rx Weighted Sparse Target Sequence calloc() failed:  540
SBMT finished:  500
Sparse Discrete Sequence calloc() failed:  505
Sparse sequence of Discrete sample times calloc() failed: 512
Sparse sequence of Target sample times calloc() failed: 534
Sparse Target Sequence calloc() failed:  541
Square root of a negative number:  522
Store srsd file lseek() failed:  544
Store srsd file open() failed:  545
Store srsd file write() failed:  543
System call free failed, errno = %d:  554
system call: calloc returned failure, errno = %d:  523
system call: exp returned failure, errno = %d:  519
system call: log returned failure:  518
system call: log2 returned failure, errno = %d:  521
system call: malloc returned failure, errno = %d:  525
system call: pow returned failure, errno = %d:  520
Target Return calloc() failed:  537
Target Samples calloc() failed:  536
Target Sequence Time calloc() failed:  542
The distance between jammer and sattelite is equal zero: 530
The distance between jammer and sattile is equal zero:  528
The distance between multipath scatterer and antenna is equal zero: 529
The number of sparse orbit positions exceeds allowed maximum: 531
This is a last CPI:  501
Tx Weighted Sparse Discrete Sequence calloc() failed:  507
Tx Weighted Sparse Target Sequence calloc() failed:  538
Unable to read header from intermediate products XDR format file:  503
Unable to reposition intermediate products XDR format file: 504
Waveform samples for Tx time instances for Discrete calloc() failed: 513
Waveform samples for Tx time instances for Target calloc() failed: 535
```

F1.5 SGEN errors:

Format of message:

<timestamp> f_sgen_... <severity> <message>

where <message>:

```
Could not fork to sbit (errno = %d):  208
Could not fork to sbmt (errno = %d):  209
Could not fork to srun (errno = %d):  207
Could not send abort generation message to ssgm (errno = %d): 206
Could not send generation complete message to ssgm (errno = %d): 205
Could not send generation run update message to ssgm (errno = %d): 210
Could not send starting generation run message to ssgm (errno = %d): 204
Debugging error flag: number %d:  219
Signal generation aborted:  220
Signal generation complete:  202
Signal generation terminated:  203
Start generation requested with run in progress:  201
Starting generation run:  200
```

F1.6 SRUN Errors:

Format of message:

<timestamp> f_srun_... <severity> <message>

where <message>:

```
Both n12.x and n12.z are zero:  307
Could not alloc enough memory for the caption data:  310
Could not attach shared memory for t_crgi_gen_parms: 331
Could not attach shared memory for t_sgen_gen_status: 329
Could not get shared memory for t_crgi_gen_parms: 330
Could not get shared memory for t_sgen_gen_status: 328
Could not open file for fd_cpi_db: 337
Could not open file for fd_runconstants: 335
Could not open file for fd_runparams: 333
Could not open the input file for the tropospheric refraction database : 315
Could not open the input IF filter response file:  312
Could not open the intermediate products file for IF filter response: 309
Could not open tmp file for checking free space on hard disk: 342
Dealloc memory for env def database failed, errno = %d: 382
Dealloc memory for run parameters database failed, errno = %d: 380
Dealloc memory for sat def database failed, errno = %d: 381
Determining the longitudinal extent for patch %d, sub-patch %d, latitude %d: 301
Determining the patch limits for patch %d, sub-patch %d:  300
Error attempting to close cpi database file, errno = %d: 321
Error attempting to close environment definition file, errno = %d: 372
Error attempting to close run constants file, errno = %d: 320
Error attempting to close run parameters file, errno = %d: 319
Error attempting to close satellite definition file, errno = %d: 373
Error attempting to detach from active status attached memory, errono = %d: 327
Error attempting to detach from gen parameters attached memory, errno = %d: 325
Error attempting to unmap cpi database memory map, errno = %d: 324
Error attempting to unmap environment definition memory map, errno = %d: 371
Error attempting to unmap run constants memory map, errno = %d: 323
Error attempting to unmap run parameters memory map, errno = %d: 322
Error attempting to unmap satellite definition memory map, errno = %d: 370
Error in the input IF filter response file:  313
Error in the input tropospheric refraction database file: 316
Error opening environment definition file - open(): 353
Error opening satellite definition file - open():  351
Error reading environment definition file - f_cend_read():  350
Error reading satellite definition file - f_crad_read():  349
Error: allocating memory for the Kaiser window vector, errno = %d: 361
Error: could not detach shared memory for the error log file descriptor, errno = %d:
       375
Error: first-time opening of Intermediate product file: 356
Error: insufficient disk space for environment definition file: 365
Error: insufficient disk space for run_constants file: 369
Error: insufficient disk space for run_parameters file: 367
Error: insufficient disk space for satellite definition file: 363
Error: No Supercard available, can't open it:  378
Error: opening environment definition file - fopen(): 364
Error: opening run_constants file - fopen():  368
Error: opening run_parameters file - fopen():  366
Error: opening satellite definition file - fopen():  362
Error: subsequent opening of Intermediate product file: 358
Error: unable to compute jammer window:  376
Error: unable to compute jammer window:  377
Error: unable to compute noise window:  326
Error: unable to compute the free disk space by calling statfs (), errno = %d: 379
Error: writing Intermediate product XDR control block: 359
Error: writing Intermediate product XDR data block: 360
Error: writing Intermediate product XDR header block: 357
Incorrect solution count returned from f_srun_get_lon_solution, patch index = %d,
subpatch index = %d, solution count = %d: 318
Insufficient disk space for RSS derived processing products: 346
Insufficient disk space for RSS Intermediate products: 345
Insufficient disk space for SRSD file: 347
Invalid earth clutter patch, patch_index is %d:  305
Invalid value in the output xdr format structure:  311
```

```
Negative argument for square root function, patch %d, sub-patch %d, latitude_index %d:
302
npplat has exceeded its limit, patch %d, latitude_index %d, npplat is %d: 304
Overflow occurred:  306
Range doppler map will have more than allowed number of range swaths : 383
Run initialization aborted: 348
Side is too close to poles, patch discarded, patch index = %d, subpatch index = %d:
317
SRUN finished:  374
The peak power of the IP filter response equal to zero:
Unable to allocate memory for data_int16 (header block): 343
Unable to allocate the memory for env_def, errno = %d:  354
Unable to allocate the memory for run parameters database, errno = %d: 334
Unable to allocate the memory for sat_def, errno = %d: 352
Unable to generate randU Gaussian samples using f_sgen_gauss(): 340
Unable to generate randV Gaussian samples using f_sgen_gauss(): 341
Unable to initialize Sub-Satellite using f_srun_init_ssp(): 339
Unable to load Signal Generation Parameters using f_srun_getparams: 332
Unable to mmap() result_cpi_db: 338
Unable to mmap() result_runconstants:  336
Unable to open SRSD output file:  355
Unable to write XDR header block using f_cgep_write(): 344
Vector has zero magnitude:  308
x12 and y12 are both zero, patch %d, sub-patch %d, latitude_index %d: 303
```

F1.7 SSGM Messages

No messages generated.

F1.8 SPMT Errors

Playback Manager messages are generated by the SPMT CSU during signal playback and processing. Format of message:

<timestamp> f_spmt_... <severity> <message>

where <message>:

```
Abort Playback requested with run not in progress:  905
Playback aborted:  904
Playback complete, iteration %d:  903
Playback terminated:  902
Start Playback requested with run in progress:  901
Starting Playback run:  900
```

F1.9 TDIT Messages

TDIT messages are generated by the RTSG Executive Controller during playback or in response to commands from the playback manager.

Format:

f_tdit_... <severity> <message>

where <message>:

```
f_tdit_dsp_interface FATAL failed to send response to TRSV
f_tdit_dsp_interface INFO received abort playback command
f_tdit_dsp_interface WARN Failed to abort playback
f_tdit_dsp_interface FATAL Failed to send abort response to SPMT
f_tdit_dsp_interface INFO received start playback command
f_tdit_dsp_interface FATAL Failed to start playback
f_tdit_dsp_interface INFO received load playback command
f_tdit_dsp_interface FATAL Failed to complete load for playback
f_tdit_initialize FATAL Failed to create rpc handle to testbed server
f_tdit_dsp_interface FATAL Failed to send load response to SPMT
f_tdit_dsp_interface WARN Invalid command received from playback manager
f_tdit_dsp_interface FATAL Failed to execute time_iteration
f_tdit_dsp_interface INFO completed playback of  iterations
f_tdit_dsp_interface FATAL Failed to send time iteration response to SPMT
f_tdit_dsp_interface WARN Timing signal received when not in run mode
f_tdit_dsp_interface FATAL tdit will terminate
f_tdit_open_log_file FATAL couldn't open status/error file
f_tdit_open_log_file FATAL failed to add log_file_fd to logTask
f_tdit_handle_err_serv_req FATAL Invalid error severity code returned from PE
f_tdit_abort_playback FATAL failed to send refresh_command to TIOP PE
tdit_abort_playback FATAL Could not receive from TIOP PE following refresh
tdit_abort_playback WARN Tried to abort playback when not running
f_tdit_initialize_log FATAL failed to open rtsg configuration file
f_tdit_initialize FATAL couldn't open status/error file
f_tdit_initialize FATAL failed to add log_file_fd to logTask
f_tdit_initialize FATAL failed to open event flag table
f_tdit_initialize_vai FATAL failed to create VAI command request msg-Q
f_tdit_initialize FATAL failed to create trsv_response_que
f_tdit_initialize_vai FATAL failed to create VAI service request msg-Q
f_tdit_initialize_log FATAL failed to connect event flag to service request msg-Q
f_tdit_initialize_vai FATAL failed to create VAI service response msg-Q
f_tdit_initialize_vai FATAL failed to create VAI signal service request msg-Q
f_tdit_initialize_log FATAL failed to connect event flag to signal service request
msg-Q
f_tdit_initialize FATAL failed to create tdit_vai_error_que
f_tdit_initialize FATAL failed to connect event flag to error msg-Q
f_tdit_initialize FATAL failed to connect system event flag to error msg-Q
f_tdit_initialize FATAL failed to spawn trsv
f_tdit_initialize FATAL failed to create device IOP
f_tdit_initialize FATAL failed to create IOP PE
f_tdit_initialize FATAL failed to open TIOP PE
f_tdit_initialize FATAL failed to read response from PE
tdit_initialize FATAL failed to open PE image file
tdit_initialize FATAL failed to determine status of image file
tdit_initialize FATAL failed to allocate EC memory for image file
tdit_initialize FATAL failed to read PE image
tdit_initialize FATAL failed to load  TIOP IOP PE executable
tdit_initialize FATAL Could not receive from PE
tdit_initialize FATAL Cannot download
tdit_initialize FATAL failed to download
tdit_initialize FATAL No data service requests received from PEs
tdit_initialize FATAL PE out of sequence - Init not received
tdit_initialize FATAL Could not write to PE
tdit_initialize FATAL No configure parameters response from PE
tdit_initialize INFO RTSG is ready
f_tdit_load_for_playback FATAL failed to send reset_command to TIOP PE
f_tdit_load_for_playback FATAL Could not receive from TIOP PE following reset
f_tdit_load_for_playback INFO srsd file:
f_tdit_load_for_playback INFO iteration count:
f_tdit_load_for_playback FATAL couldn't open SRSD output file
f_tdit_load_for_playback FATAL Failed to read srsd data file
f_tdit_load_for_playback FATAL No data service requests received from PEs for R_D_E
f_tdit_load_for_playback FATAL PE out of sequence - Run data request not received
f_tdit_load_for_playback FATAL Could not write run parameters to PE
f_tdit_load_for_playback FATAL No run parameters response from PE
f_tdit_load_for_playback FATAL No data service requests received from PEs for G1
f_tdit_load_for_playback FATAL PE out of sequence - Get data request not received
f_tdit_load_for_playback FATAL Get data request received from IOP  not IOP
f_tdit_load_for_playback FATAL Could not write srsd output buffer to IOP1
f_tdit_load_for_playback FATAL No response from PE
f_tdit_load_for_playback FATAL No data service requests received from PEs for G2
f_tdit_start_playback FATAL failed to send run_command to TIOP PE
tdit_start_playback FATAL Could not receive from TIOP PE
tdit_start_playback WARN tried to start playback when not initialized
f_tdit_time_iteration FATAL incorrect pe to host event flag received
```

F1.10 TRSV Messages

The RTSG Executive Controller may generate the following errors related to RPC communications with the RSS.

Format:

f_trsv_... <severity> <message>

where <message>:

```
f_trsv_main FATAL Failed to initialize rpc
f_trsv_main FATAL Returned from f_trsv_wait_for_cmd
f_trsv_main FATAL Returned from f_trsv_wait_for_cmd loop, and terminating ...
f_trsv_init_rpc FATAL Failed rpcTaskInit
f_trsv_init_rpc FATAL Failed to create RPC server tcp transport handle
f_trsv_init_rpc FATAL Failed to register RPC server with the OS
f_trsv_wait_for_cmd FATAL Select failed, stop waiting for command
f_trsv_dispatch FATAL Failed to get command from spmt
f_trsv_dispatch FATAL Failed to send command to tdit
f_trsv_dispatch FATAL c_tdit_ERROR_RESPONSE
f_trsv_dispatch FATAL not the expected command
f_trsv_dispatch INFO Now in default of switch (svc->...
```

F1.11 TIOP Messages

The RTSG TIOP CSU running on three IOP boards in the RTSG generates error messages which are encoded as follows:

TIOP <n> <severity> R: <r> M: <m> S:<s>

where:

<n> = 0,1,2 identifies IOP 0, 1 or 2
<severity> = INFO, WARN, FATAL
<r> = Routine number (see below)
<m> = Message number (see below)
<s> = Status word (depends on the routine and message)

Routine #	**Function Name**
1	`main`
2	`f_tiop_initialize`
3	`f_tiop_playback`
4	`f_tiop_load_new_run`

Message #	**Description**
1	`failed to initialize input handler`
2	`failed waiting for input buffer available`
3	`failed to set output buffer full`
4	`failed to signal service request to E.C.`
5	`failed while waiting for the sbi to complete`
6	`failed writing the tpm flags registers to TPM`
7	`failed playback of input radar signal data`
8	`failed to load new run`
9	`failed while waiting for the vme to complete`
10	`failed to get input radar signal data`
11	`failed to get init parameters`
12	`exceeded maximum number of tpm boards`
13	`failed clearing the TPM`
14	`failed during initialization of SPB`
15	`failed initializing the TPM`
16	`failed filling the output buffer`

Status word:

Definition depends on routine and message type. For interpretation, need to refer to the code.

F2. TESTBED CONTROLLER MESSAGES

The Testbed Controller messages have the same general format as the RSS:

<timestamp> <function> <severity> <message>

where:

<timestamp> = Time Stamp in hh:mm:ss format

<function> =

```
f_cdat_..,
f_cend_...,
f_cenh_...,
f_cerr_...,
f_cgeh_...,
f_cget_...,
f_crad_...,
f_crdh_...,
f_csdh_...,
f_csid_...,
f_csih_...,
f_csit_...,
f_csys_...,
f_cuis_...,
f_cval_...
```

<severity> = INFO, WARN, FATAL

<message> = Informational message, listed in the following in CSU order above.

F2.1 CDAT Messages

No messages.

F2.2 CEND Messages

No messages.

F2.3 CENH Messages

CRDH - Satellite/Radar Definition HMI

1. The following error messages are displayed on an Error dialog window when error was detected in reading/writing a file. The user can select a file by choosing an option under the "File" menu at the Environment HMI top-level dialog.

```
ERROR   "Environment file not readable."
ERROR   "Environment file not writeable."
ERROR   "Satellite/Radar definition file not readable."
ERROR   "Target RCS profile file does not exist.\nReset option to Provided
        Table."
ERROR   "Attempting to load non-existent file..."
```

2. The following mesages are displayed on an Error dialog window during editting of a sub-level dialog definition:

Precipitation Cell dialog

```
ERROR   "Upper alt. less than Lower alt...."
```

Discrete dialog

```
ERROR   "Peak RCS less than or equal to Median RCS...."
```

Jammer dialog

```
ERROR   "Start time greater than stop time..."
```

Clutter Patch dialog

```
ERROR   "Invalid clutter patch vertex specified..."
ERROR   "Less than three vertices specified..."
ERROR   "Cannot add vertex... limit of %d reached."
```

Time Varying Parameters Table dialog

```
ERROR   "Invalid dwell/nci/cpi combination..."
```

F2.4 CERR Messages

No messages.

F2.5 CGEH Messages

CGEH - Monitor/Control Signal Generation HMI

1. Status messages displayed on the top-level dialog.

```
"Generation Server is currently down.\nPlease startup Generation Server prior to
any executation.\n
"Validation error log is empty. Printing canceled."
"printing validation error log ..."
"Validation error log is empty. Saving canceled."
"saving validation error log ..."
"validating definition files ..."
"Error/warning found in Satellite/radar Definition file:\n%s"
"Failed to establish connection to Generation Server."
"Failed to send start command to Generation Server."
"Other signal generation is executing."
"Couldn't start signal generation.\n\nRSS Generation Manager might be down."
"Generation run in progress ..."
"Generation run successfully terminated."
"Generation run terminated with error.\nPlease see generation log file for
details."
"Failed to send abort command to Generation Server."
"No Signal Generation in progress."
"Failed to send abort command to RSS Generation Manager."
"Generation aborted successfully."
"Cannot abort. Check status of RSS Generation processes."
"Failed to send abort command to Generation Server."
"Generation run successfully terminated."
```

2. Mesages displayed on a Warning/Error dialog window.

```
ERROR     "Environment variable DISPLAY is not defined.\nPlease exit."
ERROR     "f_cgeh_comm_initialize failed.\nPlease exit."
ERROR     "Satellite/Radar or Environment Definition file\nhas not been selected
          yet.\n\nCannot execute!"
ERROR     "Generation identifier can not be null.\nPlease give it a name"
ERROR     "Failed to read Satellite/Radar Definition file."
ERROR     "Failed to read Environment Definition file."
ERROR     "Error occurred while calling CVAL to validate Satellite/Radar
          Definition."
ERROR     "Proceeding with signal generation using erroneous\nparameters might
          cause RSS problem.\n\nDo you really want to proceed?\nPress OK to proceed
          or Cancel to quit."

WARNING   "OK to exit Monitor/Control Generation ?"
WARNING   Generation Server is not running.\nPlease start Generation Server before
          executing signal generation."
WARNING   "Failed to send start command to Generation Server.\nThe Generation
          Server might be down."
WARNING   "Other signal generation is executing, please try later!"
WARNING   "Failed to send start command to RSS Generation Manager."
WARNING   "Generation server detected errors.\nPlease see log file for details."
WARNING   "Generation run terminated with error"
WARNING   "Are you sure you wish to abort the current signal generation?"
WARNING   "Failed to send abort command to Generation Server.\nThe Generation
          Server might be down."
WARNING   "No signal generation in progress.\nAbort request is denied."
WARNING   "Failed to send abort command to RSS Generation Manager.\nThe RSS
          Generation Manager might be down.\n"
WARNING   "Signal generation server detects error, abort!"
```

F2.6 CGET Messages

CGET - Controller Signal Generation Server Task

module name: cget_main

```
FATAL   "Can not create ITC identification"
FATAL   "Could not establish connection the RSS Generation Manager"
FATAL   "Could not open X display\n"
FATAL   "Environment variable RSS_NODE is not defined.\n"
FATAL   "Environment variable SPDLOG is not defined.\n"
FATAL   "Error initializing the RPC port to communicate with the HMI process."
FATAL   "Error initializing the RPC port to communicate with the RSS Signal Generation
        Manager.\n"
FATAL   "Error reading the response from the RSS generation manager"
FATAL   "Failed to initialize error file.\n"
FATAL   "Unable to send reply to the RSS Generation Manager task"
FATAL   "failed to open/read envdef: %s"
FATAL   "failed to open/read satdef: %s"
FATAL   "failed to write associated satdef: %s"
FATAL   "failed to write associated satdef: %s"
FATAL   "svc_freeargs failed after receiving RPC message.\n"
INFO    "Abort command was sent to RSS"
INFO    "Env Def pathname = %s"
INFO    "Generation ID = %s"
INFO    "Generation Manager completed signal generation"
INFO    "Generation Manager successfully aborted a generation run"
INFO    "Generation startup is successful"
INFO    "In progress %f complete\n"
INFO    "Intermediate products directory = %s"
INFO    "Launched by process %d"
INFO    "Launched by user %s"
INFO    "Launched from machine %s"
INFO    "Log file directory = %s"
INFO    "Received start signal from HMI"
INFO    "SRSD output pathname = %s"
INFO    "Sat Def pathname = %s"
INFO    "Shutdown was successful."
WARN    "Can not send abort message to RSS"
WARN    "Error reading the command from the Monitor/Control Generation Task.\n"
WARN    "Failure to send start message to the RSS"
WARN    "Generation Manager aborted a generation run with errors"
WARN    "Generation Manager aborted a signal generation activity"
```

F2.7 CRAD Messages

CRDH - Satellite/Radar Definition HMI

1. The following messages are displayed on the top-level dialog.

```
"Defining a new definition"
"Satellite/Radar Definition saved in %s"
"Antenna Model Definition saved in %s"
"Modifying a named definition file"
"Errors found in the current Satellite/radar Definition"
```

2. The following messages are displayed on a Warning/Error dialog window during editting of the top-level dialog:

```
ERROR       "An error occured in writing\nthe Satellite/Radar Definition to
            file:\n\n%s"
ERROR       "An error occured in writing\nthe Antenna Model Definition to
            file:\n\n%s"
ERROR       "Reading Satellite/Radar Definition error."
ERROR       "Failed in calling CVAL to validate Satellite/Radar Definition."
ERROR       "Reading CFA Antenna Model Definition error."

WARNING     "Save in file:\n%s"
WARNING     "OK to exit Satellite/Radar Definition?"
WARNING     "Adding too many dwells.\n\nExceed the maximum number of dwells."
WARNING     "No Dwell has been defined.\n\nCreate Dwell first before adding NCI."
WARNING     "Adding too many NCIs.\n\nExceed the maximum number of NCIs."
WARNING     "No Dwell/NCI has been defined.\n\nCreate Dwell and NCI first before
            adding NCI."
WARNING     "Adding too many CPIs.\n\nExceed the maximum number of CPIs."
WARNING     "Adding too many dwells.\n\nExceed the maximum number of dwells."
WARNING     "No Dwell has been defined.\n\nCreate Dwell first before adding NCI."
WARNING     "Adding too many NCIs.\n\nExceed the maximum number of NCIs."
WARNING     "No Dwell/NCI has been defined.\n\nCreate Dwell and NCI first before
            adding NCI."
WARNING     "Adding too many CPIs.\n\nExceed the maximum number of CPIs."
WARNING     "Press Ok button to delete the selected object or press Cancel button to
            quit."
WARNING     "Cannot delete Dwell interval.\n\nAt least one dwell must exist at the
            run level."
WARNING     "Cannot delete NCI interval.\n\nAt least one NCI must exist in the
            current dwell."
WARNING     "Cannot delete CPI interval.\n\nAt least one CPI must exist in the
            current NCI."
WARNING     "OK to set Antenna Model Definition with defaults?"
WARNING     "Enable capturing all CPI intervals ?\n\nThis cannot be undone."
WARNING     "Disable capturing all CPI intervals ?\n\nThis cannot be undone."
```

3. The following mesages are displayed on a Warning/Error dialog window during editting of a sub-level dialog definition:

Auxiliary arbitrary array dialog.

```
WARNING     "Change all user-entered parameter values of the existing elements
            back\nto their defaults?"
```

Auxiliary Regular array dialog.

```
WARNING     "Modifying this parameter will change the range\nof the following
            dependent parameters:\n\n  - Elevation\n  - Azimuth\n\nThe current value
            of the dependent parameter(s)\nis out of the new range.\nOK to set to
            default value(s)?"
```

Channel Selections dialog

ERROR	"Number of auxiliaries/taps exceeds 16. \n \nPlease delete some taps before \nincreasing number of auxiliaries."
ERROR	"Number of auxiliaries/taps exceeds 16. \n \nPlease delete some auxiliaries/taps \nbefore selecting this delay tap."

Generation Options dialog

WARNING	"Earth Clutter factor is greater than\nJammer and Noise factor.\n\nSet Jammer and Noise factor\nequal to Earth Clutter factor."
WARNING	"Earth Clutter factor is greater than\nJammer and Noise factor.\n\nSet Earth Clutter factor\nequal to Jammer and Noise factor."

Jammmer Multipath dialog

WARNING	"Change all user-entered parameter values of the existing elements back\nto their defaults?"

Radar concept dialog

WARNING	"OK to change Mid-band Frequency and RF Bandwidth to\ntheir defaults?"

F2.8 CRDH Messages

CRDH - Satellite/Radar Definition HMI

1. The following messages are displayed on the top-level dialog.

```
"Defining a new definition"
"Satellite/Radar Definition saved in %s"
"Antenna Model Definition saved in %s"
"Modifying a named definition file"
"Errors found in the current Satellite/radar Definition"
```

2. The following messages are displayed on a Warning/Error dialog window during editting of the top-level dialog:

```
ERROR      "An error occured in writing\nthe Satellite/Radar Definition to
           file:\n\n%s"
ERROR      "An error occured in writing\nthe Antenna Model Definition to
           file:\n\n%s"
ERROR      "Reading Satellite/Radar Definition error."
ERROR      "Failed in calling CVAL to validate Satellite/Radar Definition."
ERROR      "Reading CPA Antenna Model Definition error."

WARNING    "Save in file:\n%s"
WARNING    "OK to exit Satellite/Radar Definition?"
WARNING    "Adding too many dwells.\n\nExceed the maximum number of dwells."
WARNING    "No Dwell has been defined.\n\nCreate Dwell first before adding NCI."
WARNING    "Adding too many NCIs.\n\nExceed the maximum number of NCIs."
WARNING    "No Dwell/NCI has been defined.\n\nCreate Dwell and NCI first before
           adding NCI."
WARNING    "Adding too many CPIs.\n\nExceed the maximum number of CPIs."
WARNING    "Adding too many dwells.\n\nExceed the maximum number of dwells."
WARNING    "No Dwell has been defined.\n\nCreate Dwell first before adding NCI."
WARNING    "Adding too many NCIs.\n\nExceed the maximum number of NCIs."
WARNING    "No Dwell/NCI has been defined.\n\nCreate Dwell and NCI first before
           adding NCI."
WARNING    "Adding too many CPIs.\n\nExceed the maximum number of CPIs."
WARNING    "Press Ok button to delete the selected object or press Cancel button to
           quit."
WARNING    "Cannot delete Dwell interval.\n\nAt least one dwell must exist at the
           run level."
WARNING    "Cannot delete NCI interval.\n\nAt least one NCI must exist in the
           current dwell."
WARNING    "Cannot delete CPI interval.\n\nAt least one CPI must exist in the
           current NCI."
WARNING    "OK to set Antenna Model Definition with defaults?"
WARNING    "Enable capturing all CPI intervals ?\n\nThis cannot be undone."
WARNING    "Disable capturing all CPI intervals ?\n\nThis cannot be undone."
```

3. The following mesages are displayed on a Warning/Error dialog window during editting of a sub-level dialog definition:

Auxiliary arbitrary array dialog.

```
WARNING "Change all user-entered parameter values of the existing elements
back\nto their defaults?"
```

Auxiliary Regular array dialog.

```
WARNING    "Modifying this parameter will change the range\nof the following
           dependent parameters:\n\n  - Elevation\n  - Azimuth\n\nThe current value
           of the dependent parameter(s)\nis out of the new range.\nOK to set to
           default value(s)?"
```

Channel Selections dialog

```
ERROR     "Number of auxiliaries/taps exceeds 16. \n \nPlease delete some taps
          before \nincreasing number of auxiliaries."
ERROR     "Number of auxiliaries/taps exceeds 16. \n \nPlease delete some
          auxiliaries/taps \nbefore selecting this delay tap."
```

Generation Options dialog

```
WARNING   "Earth Clutter factor is greater than\nJammer and Noise factor.\n\nSet
          Jammer and Noise factor\nequal to Earth Clutter factor."
WARNING   "Earth Clutter factor is greater than\nJammer and Noise factor.\n\nSet
          Earth Clutter factor\nequal to Jammer and Noise factor."
```

Jammmer Multipath dialog

```
WARNING   "Change all user-entered parameter values of the existing elements
          back\nto their defaults?"
```

Radar concept dialog

```
WARNING   "OK to change Mid-band Frequency and RF Bandwidth to\ntheir defaults?"
```

F2.9 CSDH Messages

CSDH - Simulation Run Definition HMI

1. The following messages are displayed on the top-level dialog.

```
"Please select a Signal Data file first before defining a new Simulation Run
Definition"
"Simulation Run Definition saved in %s"
"Error occured while opening the associated Satellite/Radar file"
"Define a new Simulation Run Definition"
"Define a named Simulation Run Definition file"
"An error occured while reading the associated Satellite/Radar file:\n\n%s"
"Modify Simulation Run Definition file: %s"
"Error found in the current Simulation/Run Definition."
"Modify Simulation Run Definition file: %s"
```

2. The following messages are displayed on a Info/Warning/Error dialog window during editting of the top-level dialog:

```
INFO     "Can not saved since the Signal Data file\nhas not been selected yet."
INFO     "No RAR parameters are changeable at Run level."
INFO     "Please select a signal data file first."

ERROR    "An error occured in writing the associated Satellite/Radar Definition to
         file:\n\n%s"
ERROR    "An error occured in writing\nthe Simulation Run Definition to
         file:\n\n%s"
ERROR    "Reading Simulation Run Definition error."
ERROR    "An error occured while reading the associated Satellite/Radar
         file:\n\n%s"
ERROR    "An error occured while reading the Signal Data file:\n\n%s"
ERROR    "Failed in calling CVAL to validate Simulation/Run Definition."

WARNING  "Save in file:\n%s"
WARNING  "OK to exit Simulation Run Definition?"
WARNING  "The associated Satellite/Radar Definition file does not exist:\n\n%s"
WARNING  "Enable capturing all products at Dwell level?\n\nThis cannot be undone."
WARNING  "Disable capturing all products at Dwell level?\n\nThis cannot be
         undone."
WARNING  "Enable capturing all products at NCI level?\n\nThis cannot be undone."
WARNING  "Disable capturing all products at NCI level?\n\nThis cannot be undone."
WARNING  "Disable capturing all products at CPI level?\n\nThis cannot be undone."
WARNING  "Enable capturing all products at CPI level?\n\nThis cannot be undone."
```

3. The following mesages are displayed on a Warning/Error dialog window during editting of a sub-level dialog definition:

Adaptive Nulling dialog

```
WARNING  "Changing filter length will set all user-entered weights\n back to their
         default values.  Is this OK?"
```

DSP Configuration dialog

```
WARNING  "Changing number of Range-Doppler blankers or\nnumber of Post-Doppler
         blankers will reset\nblanker channel assignments and\ntheir nulling
         channels to defaults."
WARNING  "Changing DPCA mode or monopulse will\nreset the formed beam selection
         and\nPC nulling channels to defaults."
```

NCI Digital PMC dialog

```
WARNING  "Press Yes button to change FFT length to default value\n\nor\n\nPress
         Cancel button to have the Number of Pulses Processes unchanged."
```

Pre-Doppler Blanking dialog

```
ERROR  "Both Noise and Slope thresholds must not have 0."
```

F2.10 CSID Messages

No messages.

F2.11 CSIH Messages

CSIH - Monitor/Control Simulation Run HMI

1. Status messages displayed on the top-level dialog.

```
"Environment variable SPDMGRBIN is not defined.\nPlease exit."
"Environment variable CTLR_NODE is not defined.\nPlease exit."
"Simulation Server is currently down.\nPlease startup Simulation Server prior to
any executation.\n"
"validating definition files ...")
"Validation error log is empty. Printing canceled."
"printing validation error log ..."
"Validation error log is empty. Saving canceled."
"saving validation error log ..."
"Error/warning found in Simulation Run Definition file:\n%s
"Failed to establish connection to Simulation Server."
"Failed to send start command to Simulation Server."
"Failed to send start command to RSS Simulation Manager."
"Simulation run in progress ..."
"Simulation run successfully terminated."
"Simulation run terminated with error.\nPlease see simulation log file for
details."
"Failed to send abort command to Simulation Server."
"Failed to send abort command to RSS Simulation Manager."
"Simulation run aborted successfully."
"Can't abort. Check status of RSS Simulation processes."
"Failed to send abort command to Simulation Server.\nThe Simulation Server was
already terminated."
```

2. Mesages displayed on a Warning/Error dialog window.

```
ERROR     "Environment variable SPDMGRBIN is not defined.\nPlease exit."
ERROR     "Environment variable CTLR_NODE is not defined.\nPlease exit."
ERROR     "Simulation run or Signal Data file has not been selected yet.\nCannot
          execute."
ERROR     "Simulation identifier can not be null.\nPlease give it a name"
ERROR     "An error ocurred while reading Simulation Run Definition file:\n%s"
ERROR     "An error ocurred while reading the RSS Derived Processing Parameters
          file:\n%s"
ERROR     "Both associated Satellite/Radar Definition files do not
          exist:\n\n%s\n\n%s"
ERROR     "Press Ok button to proceed or\npress Cancel button to quit."
ERROR     "Both associated SRSD files do not exist:\n\n%s\n\n%s"
ERROR     "The associated SRSD file does not exist:\n\n   %s\n\nUse the following
          SRSD file instead:\n\n   %s
ERROR     "An error ocurred while reading the associated Satellite/Radar Definition
          file:\n\n   %s"
ERROR     "Error occurred while calling CVAL to validate Simulation Run
          Definition."
ERROR     "Proceeding with simulation run using erroneous\nparameters might cause
          RSS problem.\n\nDo you really want to proceed?\nPress OK to proceed or
          Cancel to quit."

WARNING   "OK to exit Monitor/Control Simulation ?"
WARNING   "Simulation Server is not running.\nPlease start Simulation Server before
          executing simulation run."
WARNING   "Failed to send start command to Simulation Server.\nThe Simulation
          Server might be down."
WARNING   "Other simulation run is executing, please try later!"
WARNING   "Failed to send start command to RSS Simulation Manager."
WARNING   "Simulation server detects error, abort! "
WARNING   "Error in ESP or RSP has occured. \nCheck error log file for details."
WARNING   "Simulation run terminated with error"
WARNING   "Are you sure you want to abort the current simulation run?"
WARNING   "Failed to send abort command to Simulation Server.\nThe Simulation
          Server was already terminated."
WARNING   "No simulation run in progress.\nAbort request is denied."
WARNING   "Failed to send abort command to RSS Simulation Manager.\nRSS Simulation
          Manager was already terminated.\n"
WARNING   "Simulation server detected errors.\nPlease see log file for details."
WARNING   "ESP or RSP have failed to abort."
WARNING  "Failed to send abort command to Simulation Server.\nThe Simulation
         Server was already terminated."
```

F2.12 CSIT Messages

CSIT - Controller Simulation Run Server Task

module_name: csit_main

```
FATAL    "Can not create ITC identification"
FATAL    "Can not obtain SRSD file timestamp"
FATAL    "Can not obtain Sim. Def. file timestamp"
FATAL    "Can not obtain processing parameters file timestamp"
FATAL    "Can not send abort message to RSS"
FATAL    "Could not get client handle for ESP"
FATAL    "Could not get client handle for RSP"
FATAL    "Could not read RSS Processing Parameters file: %s"
FATAL    "Could not read Simulation Definition file: %s",
FATAL    "Could not read the associated Satellite/Radar Definition file: %s"
FATAL    "Could not send %s command to ESP"
FATAL    "Could not send %s command to RSP"
FATAL    "Could not send %s command to RSS"
FATAL    "Could not send abort to RSS"
FATAL    "Could not send stop to ESP"
FATAL    "Could not send stop to RSP"
FATAL    "Could not write parameters into file"
FATAL    "ESP Failed update or configure call"
FATAL    "ESP or RSP is not ready"
FATAL    "ESP returned error from %s command"
FATAL    "ESP returned error from provide status command"
FATAL    "ESP returned error from stop command"
FATAL    "Environment variable ESP_NODE is not defined.\n"
FATAL    "Environment variable RSP_NODE is not defined \n"
FATAL    "Environment variable RSS_NODE is not defined.\n"
FATAL    "Environment variable SPDLOG is not defined.\n"
FATAL    "Error initializing the RPC port to communicate with the DSP.\n"
FATAL    "Error initializing the RPC port to communicate with the HMI process.\n
FATAL    "Error initializing the RPC port to communicate with the RSS Playback
         Manager.\n"
FATAL    "Error reading RSS message"
FATAL    "Error reading RSS message"
FATAL    "Failed to initialize error file: %s\n"
FATAL    "Failed to open X Display\n"
FATAL    "RSP Failed update or configure call"
FATAL    "RSP returned error from %s command"
FATAL    "RSP returned error from provide status command"
FATAL    "RSP returned error from stop command"
FATAL    "The SRSD file does not exist: %s"
FATAL    "The associated Satellite/Radar Definition file does not exist: %s"
FATAL    "Unable to send reply to the RSS Simulation Manager task"
FATAL    "error opening the detection file for writing"
FATAL    "the RPC clnt_control call has failed to change timeout period for the
         ESP port.\n"
FATAL    "the RPC clnt_control call has failed to change timeout period for the
         RSP port.\n"
FATAL    "the RPC clnt_control call has failed to change timeout period for the
         RSS port.\n"
FATAL    "the RPC clnt_create call has failed to establish link to ESP.\n "
FATAL    "the RPC clnt_create call has failed to establish link to RSP.\n "
FATAL    "the RPC clnt_create call has failed to establish link to RSS.rn "
FATAL    "unable to free arguments from the DSP message\n"
FATAL    "unable to free arguments from the Monitor/Control Simulation task\n"
FATAL    "xdr_setpos for control block failed\n"
FATAL    "xdr_setpos for header block failed\n"
FATAL    "xdr_t_csip_NCI_cntr_blk failed\n"
FATAL    "xdr_t_csip_NCI_cntr_block failed"
FATAL    "xdr_t_csip_detect failed in writing detection data to file"
FATAL    "xdr_t_csip_header_block failed"
FATAL    "xdr_t_csip_header_block failed\n"
INFO     "Abort command was sent to RSS"
INFO     "Abort command was sent to RSS"
INFO     "Associated Satellite/Radar definition file pathname = %s"
INFO     "Associated Signal file pathname = %s"
INFO     "Average Duration per iteration=%f"
INFO     "Average Realtime Factor=%f"
INFO     "Could not change file mode, %s\n"
INFO     "Could not open file, %s\n"
INFO    "Iteration %d: Duration=%f, Realtime Factor=%f"
INFO    "Launched by process %d"
INFO    "Launched by user %s"
INFO    "Launched from machine %s
INFO    "Log file directory = %s"
INFO    "Output file directory = %s"
INFO    "Parameter file directory = %s"
INFO    "RSS derived processing parameters pathname = %s"
INFO    "Received complete detection data of the last iteration"
INFO    "Received shutdown command"
INFO    "Received start command from the HMI"
INFO    "Second attempt to access the SRSD file: %s"
INFO    "Second attempt to access the associated Satellite/Radar Definition file:
        %s"
INFO    "Send abort command to RSS"
INFO    "Send configure command to ESP"
INFO    "Send configure command to RSP"
INFO    "Send provide status command to ESP"
INFO    "Send provide status command to RSP"
INFO    "Send run command to ESP"
INFO    "Send run command to RSP"
INFO    "Send start playback command to RSS"
INFO    "Send update command to ESP"
INFO    "Send update command to RSP"
INFO    "Sent stop command to ESP"
INFO    "Sent stop command to RSP"
INFO    "Simulation Manager completed signal run"
INFO    "Simulation Manager successfully aborted a signal run"
INFO    "Simulation Run ID = %s"
INFO    "Simulation definition file pathname = %s"
INFO    "The SRSD file does not exist: %s"
INFO    "The associated Satellite/Radar Definition file does not exist: %s"
INFO    "Total Elapsed Time for %d iterations=%f"
INFO    "Tx Waveform Duration=%f"
WARN    "ESP sent failure message"
WARN    "RSP sent failure message"
WARN    "RSP/ESP in inconsistent state - Sending 'Stop'"
WARN    "Simulation Manager aborted a signal run with errors"
WARN    "Simulation Manager failed during a signal run"
WARN    "error reading the command from the Monitor/Control Simulation Task\n"
```

F2.13 CSYS Messages

CSYS CSU - System and Control

The following messages are displayed on the screen to provide the user interactive response. The syntax is:

%<error messge> - on the unix prompt

module_name: csys_genshutdown

```
FATAL " %s : environment variable RSS_NODE is not defined , abort\n"
FATAL " %s  : environment variable CTLR_NODE is not defined,abort \n"
WARN  "A signal generation job is currently running.\nDo you want to kill it? [Y] : "
INFO  "The RSS manager process was already terminated\n"
INFO  "The Generation Server process was already terminated\n"
INFO  "Signal generation continuing\n"
INFO  "All generation manager processes are already terminated\n"
```

module_name: csys_genstart

```
FATAL "%s FATAL Environment variable SPDLOG is not defined.\n"
FATAL "%s FATAL Environment variable SPDMGRBIN is not defined.\n"
FATAL "%s FATAL Environment variable RSS_NODE is not defined.\n"
FATAL "%s FATAL Environment variable CTLR_NODE is not defined.\n"
FATAL "%s : Communication problem: can not connect to RSS\n"
FATAL "%s : Communication problem: can not create client with Controller"
WARN  "Timed attempting to reach RSS:  retrying/n"
WARN  "The RSS Manager is in a generation run. Do you want to kill it ? [Y] : "
INFO  "%s : both tasks are up and running,this program is terminated\n"
```

module_name: csys_simshdwn

```
FATAL " %s : environment variable RSS_NODE is not defined , abort\n"
FATAL " %s  : environment variable CTLR_NODE is not defined,abort \n"
WARN  "A simulation run job is currently running.\nDo you want to kill it? [Y] : "
INFO  "The RSS manager process was already terminated\n"
INFO  "The Simulation Server process was already terminated\n"
INFO  "Signal simulation continuing\n"
INFO  "All simulation manager processes are already terminated\n"
```

module_name: csys_simstart

```
FATAL "%s FATAL Environment variable SPDLOG is not defined.\n"
FATAL "%s FATAL Environment variable SPDMGRBIN is not defined.\n"
FATAL "%s FATAL Environment variable RSS_NODE is not defined.n"
FATAL "%s FATAL Environment variable CTLR_NODE is not defined.n"
FATAL "%s : Communication problem: can not connect to RSS\n"
FATAL "%s : Communication problem: can not create client with Controller"
WARN  "Timed attempting to reach RSS:  retrying/n"
WARN  "The RSS Manager is in a simulation run. Do you want to kill it ? [Y] : "
INFO  "%s INFO Both servers are up and running, this program is terminated.\n"
```

F2.14 CUIS Messages

No messages.

F2.15 CVAL Messages

The Testbed Controller validation software (CVAL) performs a number of consistency checks on simulation definitions to detect conditions that may cause a simulation run to fail. The following lists conditions detected by CVAL that are reported back as non-fatal, however, the condition may result in a warning or fatal error if the simulation is attempted. In the messages, "%d" is a formatting code to print a decimal integer value.

Messages:

```
Code 0 : ERROR Incompatible DI field in run-time and satellite/radar definition files

Code 1 : ERROR Incompatible NCI field in run-time and satellite/radar definition files

Code 2 : ERROR Incompatible CPI field in run-time and satellite/radar definition files

Code 3 : Channel Selections .. Number of Phase Centres per Group, ERROR DPCA requires
two or more phase centres per group

Code 4 : Channel Selections .. Number of Phase Centres per Group, ERROR Monopulse
requires more phase centres

Code 5 : ERROR number of range Doppler blankers exceeds maximum allowed

Code 6 : ERROR number of blankers exceeds number of auxiliaries

Code 7 : Channel Selections .. Number of Phase Centres per Group, ERROR MASR requires
more phase centres to operate with monopulse

Code 8 : ERROR sampling correction not compatible with PRF-adjusted system

Code 9 : WARNING number of nulling channels for system %d phase centre %d exceeds
number of dof

Code 10 : ERROR number of nulling channels for system %d phase centre %d exceeds
number allowed

Code 11 : ERROR nulling channel %d for system %d phase centre %d exceeds number of
channels

Code 12 : WARNING nulling channel %d for system %d phase centre %d is a main beam

Code 13 : WARNING nulling channels %d %d for system %d phase centre %d are the same

Code 14 : Dwell Level CFAR .. Doppler Width, ERROR CFAR Doppler width greater than %d
DI = %d

Code 15 : Dwell Level CFAR .. Range Width, ERROR CFAR Range width greater than %d DI =
%d

Code 16 : Dwell Level CFAR .. Range Width/Doppler Width, ERROR CFAR Range width and
Doppler width cannot both be 1 DI = %d

Code 17 : Dwell Level CFAR .. Guard Doppler Width, ERROR CFAR Guard Doppler width
greater than Doppler width DI = %d

Code 18 : Dwell Level CFAR .. Guard Range Width, ERROR CFAR Guard range width greater
than Range Width DI = %d

Code 19 : Dwell Level CFAR .. Doppler Width, ERROR CFAR guard range width and guard
Doppler width cannot both be maximum DI = %d

Code 20 : ERROR insufficient memory for CFAR DI = %d, NCI = %d

Code 21 : WARNING no post-NCI data captured DI = %d, NCI = %d

Code 22 : WARNING no pre-Doppler data captured DI = %d, NCI = %d

Code 23 : WARNING no post-PC data captured DI = %d, NCI = %d

Code 24 : INFO total intermediate data is %d bytes
```

Code 25 : ERROR incompatible sat_def and run_def files

Code 26 : ERROR ASAR DPCA must have pulse-Doppler enabled

Code 27 : Dwell Level ASAR DPCA .. Number of DPCA Doppler bins, ERROR Doppler cells greater than %d DI = %d

Code 28 : Dwell Level Pulse Doppler .. FFT Length, ERROR FFT length less than (number of pulses processed %d - PRI multiplier %d), DI = %d, NCI = %d

Code 29 : Dwell Level ASAR DPCA .. Number of Range Gates, ERROR DPCA range gates greater than %d DI = %d, NCI = %d

Code 30 : Dwell Level ASAR DPCA .. start gate and step, ERROR ASAR last gate %d goes beyond ambiguous range %d DI = %d, NCI = %d

Code 31 : ERROR insufficient memory for non-coherent integration DI = %d, NCI = %d

Code 32 : Adaptive Nulling .. Snapshot Smmoothing Period, ERROR smoothing period less than %f ms (M = %d)

Code 33 : Adaptive Nulling .. Snapshots per Smoothing Interval, ERROR snapshots less than M = %d

Code 34 : Adaptive Nulling .. Snapshots per Smoothing Interval, ERROR snapshots greater than samples per smoothing period %d

Code 35 : Adaptive Nulling .. Update Intervals per Smoothing Interval, ERROR update intervals smoothed greater than snapshots

Code 36 : Adaptive Nulling .. Snapshots Rejected, ERROR snapshots rejected greater than %d

Code 37 : ERROR insufficient memory for weight computation, reduce system size or number of smoothed intervals

Code 38 : Adaptive Nulling .. Snapshot Smmoothing Period, WARNING smoothing period longer than processed CPIs time %f ms DI = %d, NCI = %d

Code 39 : ERROR weights unable to fit in TPM, reduce system size or number of updates

Code 40 : ERROR Doppler compensation not applicable without pulse compression

Code 41 : ERROR insufficient memory for pulse compression DI = %d, NCI = %d

Code 42 : Dwell Level Pulse Doppler .. Unambiguous PRF, ERROR unambiguous PRF less than %f KHz DI = %d

Code 43 : Dwell Level Pulse Doppler .. Unambiguous PRF, ERROR unambiguous PRF greater than %f KHz DI = %d

Code 44 : ERROR number of nulling channels for system %d exceeds %d

Code 45 : ERROR number of pulses processed greater than number transmitted DI = %d, NCI = %d

Code 46 : ERROR unreadable sat_def file

Code 47 : ERROR burst time %f ms less than allowed minimum %f ms DI = %d, NCI = %d

Code 48 : WARNING no post-Doppler data captured DI = %d, NCI = %d

F3. ESP MESSAGES

ESP messages originate from two sources:

1. Executive Controller CSUs: EMAN, ERSV and ETBI
2. VASP PE CSUs: ERSI, EWVU, ESIG, ERSO, EUTL

The general format of ESP errors is:

<function> <severity> <message>

ESP messages do not have a time stamp for ESP EC messages:

<function> = f_eman, f_ersv, f_etbi

<severity> = INFO, WARN, FATAL

<message> = Informational messages listed below (sections B3.1 to B3.3)

For ESP PE errors:

<function> =

```
ERSI <i>           (i = 0,1,2 identifies input IOPs)
EWVU <j>           (j = 0,1,2,3 is the weight vector update PE)
ESIG <k>           (k = 0,1,..,31 is a weighted-sums PE)
ERSO <l>           (l = 0,1 is an output IOP)
```

F3.1 EMAN Messages

The following messages originate from the ESP Manager (EMAN) CSU:

```
f_eman_esp_manager INFO ESP Manager is Ready
f_eman_esp_manager FATAL failed to provide status
f_eman_esp_manager FATAL failed to send response to ERSV
f_eman_esp_manager FATAL failed hardware reset
f_eman_esp_manager FATAL failed DSP configuration
f_eman_esp_manager FATAL failed PE parameter update
f_eman_esp_manager FATAL failed to create rpc handle to testbed server
f_eman_esp_manager FATAL failed to send complete acknowledge to TestBed Controller
f_eman_esp_manager WARN cannot configure - not in ready state
f_eman_esp_manager FATAL parameter update failed
f_eman_esp_manager WARN Not updated - not in ready state
f_eman_esp_manager FATAL failed to start processing
f_eman_esp_manager WARN Not configured/updated to begin processing
f_eman_esp_manager WARN Will ignore Run command and remain in Ready state.
f_eman_esp_manager WARN Not in correct state to begin processing
f_eman_esp_manager FATAL failed to stop processing
f_eman_esp_manager WARN PEs not running when stop command received
f_eman_esp_manager WARN Invalid command received from testbed server
f_eman_esp_manager FATAL esp manager will terminate
f_eman_initialize_log error: couldn't open status/error file
f_eman_initialize_log error: failed to add log_file_fd to logTask
f_eman_initialize_log error: failed to open event flag table
f_eman_initialize_log error: failed to create eman_vai_error_que
f_eman_initialize_log error: failed to connect event flag to error msg-Q
f_eman_initialize_vai error: failed to create VAI command request msg-Q
f_eman_initialize_vai error: failed to create VAI service response msg-Q
f_eman_initialize_vai error: failed to create VAI service request msg-Q
f_eman_initialize_log error: failed to connect event flag to service request msg-Q
f_eman_initialize_vai error: failed to create ersv service response msg-Q
f_eman_initialize_log error: Failed to open ESP configuration file
f_eman_initialize_log error: Failed to create device GSP
f_eman_initialize_log error: Failed to create GSP PE
f_eman_initialize_log error: Failed to create device IOP
f_eman_initialize_log error: Failed to create IOP PE
f_eman_initialize_log error: Failed to open RSI PE
f_eman_initialize_log error: Failed to open RSO PE
f_eman_initialize_log error: Failed to open WVU PE
f_eman_initialize_log error: Failed to open SIG PE
f_eman_initialize_log error: Failed to read response from PE
eman_configure_dsp error FATAL: Failed to open PE image file
eman_configure_dsp error FATAL: Failed to determine status of image file
eman_configure_dsp error FATAL: Failed to allocate EC memory for image file
eman_configure_dsp error FATAL: Failed to read PE image
eman_configure_dsp error FATAL: Failed to load ERSO IOP PE executable
eman_configure_dsp error FATAL: Failed to load ESIG GSP PE executable
eman_configure_dsp error FATAL: Failed to load EWVU GSP PE executable
eman_configure_dsp error FATAL: Failed to load ERSI IOP PE executable
eman_configure_dsp error FATAL: Could not receive from PE
eman_configure_dsp error FATAL: Cannot download
eman_configure_dsp error FATAL: Failed to download
eman_configure_dsp error FATAL: Data service request not received from PE
eman_configure_dsp error FATAL: PE out of sequence - Init not received
eman_configure_dsp error FATAL: Could not decode stage from devUsage string in data
                                service request
eman_configure_dsp error FATAL: Could not write to PE
eman_configure_dsp error FATAL: No configure parameters response from PE
f_eman_configure_log error: Failed to open RSI PE
f_eman_configure_log error: Failed to open RSO PE
f_eman_configure_log error: Failed to open WVU PE
f_eman_configure_log error: Failed to open SIG PE
f_eman_configure_log error: Failed to read response from PE
f_proc_stat_msg error FATAL Invalid error severity code returned from PE
f_proc_stat_msg error FATAL: Incorrect message type for an error
f_eman_prv_stat_log error FATAL: failed to provide status to ERSV
f_eman_reset_hdware error FATAL: failed to reset IOP 1
f_eman_reset_hdware error FATAL: failed to reset IOP
f_eman_reset_hdware error FATAL: failed to reset GSP
f_eman_reset_hdware error FATAL: failed to reset GSP
f_eman_run_dsp error: failed to send run_command to RSO PE
eman_run_dsp error FATAL: Could not receive from RSO PE
f_eman_run_dsp error FATAL: failed to send run_command to SIG PE
eman_run_dsp error FATAL: Could not receive from SIG PE
```

```
f_eman_run_dsp error: failed to send run_command to WVU PE
eman_run_dsp error FATAL: Could not receive from WVU PE
f_eman_run_dsp error: failed to send run_command to RSI PE
eman_run_dsp error FATAL: Could not receive from RSI PE
eman_updt_pe_params WARN: Synchronization delay incomplete
f_eman_updt_pe_params error: failed to send synchronize_event_flag to RSO PE
f_eman_updt_pe_params error FATAL: failed to send synchronize_event_flag to SIG PE
f_eman_updt_pe_params error: failed to send synchronize_event_flag to WVU PE
f_eman_updt_pe_params error: failed to send synchronize_event_flag to RSI PE
eman_updt_pe_params error FATAL: Could not receive from PE
f_eman_stop_dsp error: failed to send stop_command to RSI PE
f_eman_stop_dsp error: failed to send stop_command to WVU PE
f_eman_stop_dsp error FATAL: failed to send stop_command to SIG PE
f_eman_stop_dsp error: failed to send stop_command to RSO PE
f_eman_stop_dsp error FATAL: Could not receive from PE
f_eman_updt_pe_params error: failed to send update_event_flag to RSO PE
f_eman_updt_pe_params error FATAL: failed to send update_event_flag to SIG PE
f_eman_updt_pe_params error: failed to send update_event_flag to WVU PE
f_eman_updt_pe_params error: failed to send update_event_flag to RSI PE
eman_updt_pe_params error FATAL: Could not receive from PE
eman_updt_pe_params error FATAL: No data service requests received from PEs
eman_updt_pe_params error FATAL: PE out of sequence - Run_data request not received
eman_updt_pe_params error FATAL: Could not write to PE
eman_updt_pe_params error FATAL: No response received from PE
eman_updt_pe_params WARN: Synchronization delay incomplete
```

F3.2 ERSV Messages

The following messages originate from the ESP RPC server CSU (ERSV):

```
f_ersv_main FATAL Failed to initialize ESP-Testbed Controller interface
f_ersv_main FATAL Returned from f_ersv_wait_for_cmd
f_ersv_init_rpc FATAL Failed rpcTaskInit
f_ersv_init_rpc FATAL Failed to create RPC server tcp transport handle
f_ersv_init_rpc FATAL Failed to register RPC server with the OS
f_ersv_wait_for_cmd FATAL Select failed
f_ersv_terminate_wait_for_cmd WARN failed to send DSP unit error message to Testbed
controller
f_ersv_dispatch FATAL Could not allocate memory
f_ersv_dispatch INFO received command
f_ersv_dispatch FATAL failed to get command from Testbed Controller
f_ersv_dispatch FATAL failed to send ommand to testbed interface
f_ersv_dispatch FATAL failed to receive command_acknowledge from testbed interface
f_ersv_dispatch FATAL not expected command acknowledge signal
f_ersv_dispatch FATAL failed to receive completion_acknowledge from testbed interface
f_ersv_dispatch WARN failed to delete error status log file from logTask
f_ersv_dispatch WARN error receiving completion acknowledge signal
f_ersv_dispatch WARN error recieveing status log message
f_ersv_dispatch INFO Now in default of switch (svc->...
```

F3.3 ETBI Messages

The following messages originate from the ESP Testbed Interface CSU:

```
f_etbi_testbed_interface FATAL: failed to send command acknowledge to rpc server
f_etbi_testbed_interface FATAL: failed to send command to esp manager
f_etbi_testbed_interface FATAL: failed to succesfully flush vai queue after stop
                                command
f_etbi_testbed_interface FATAL failed to built filename
f_etbi_testbed_interface WARN: Invalid command received on g_etbi_esp_commands_que
f_etbi_testbed_interface FATAL: failed to get intermediate data
f_etbi_testbed_interface error FATAL: Terminating testbed interface task
f_etbi_initialize_log error: failed to open event flag table
f_etbi_initialize FATAL failed to creat esp command que
f_etbi_initialize FATAL failed to creat vai_srq_que
f_etbi_initialize FATAL failed to ioctl, file descriptor does not exist
f_etbi_initialize FATAL failed to creat vai_response_que
f_etbi_get_idata FATAL failed to get pe_fd
f_etbi_get_idata FATAL failed to write command to pe
f_etbi_get_idata FATAL failed to receive first response from pe
f_etbi_get_idata FATAL failed to read int_data_message from pe
f_etbi_get_idata FATAL failed to set pe to pe event flag
f_etbi_get_idata FATAL failed to receive response from pe
f_etbi_get_idata FATAL failed to get the int data from pe
f_etbi_get_idata FATAL failed to set pe to pe event flag
f_etbi_get_idata FATAL failed to call f_etbi_write_idata
f_etbi_get_idata FATAL pe response error, respStatus= , transactionStatus=
f_etbi_get_idata FATAL pe first response error, respStatus= , transactionStatus=
f_get_pe_fd FATAL not the right pe
f_etbi_write_idata FATAL failed to built filename
f_etbi_write_idata FATAL failed to open file
f_etbi_write_idata FATAL allocating memory buffer
f_etbi_write_idata FATAL failed to copy SRSD pathname
f_etbi_write_idata FATAL failed to copy simdef pathname
f_etbi_write_idata FATAL xdr_t_csip_header_block failed
f_etbi_write_idata FATAL failed f_write_cpi_control block
f_etbi_write_idata FATAL failed f_write_di_control block
f_etbi_write_idata FATAL failed write buf into file
f_etbi_write_idata FATAL xdr_setpos set to 0 failed
f_etbi_write_idata FATAL failed f_write_isi
f_etbi_write_idata FATAL failed f_write_pd_window
f_etbi_write_idata FATAL failed f_write_rpc
f_etbi_write_idata FATAL failed f_updt_cpi_control
f_etbi_write_idata FATAL failed f_updt_di_control
f_etbi_write_idata FATAL failed to malloc on DIs, abort!
f_etbi_write_idata FATAL failed to malloc on NCIs, abort!
f_etbi_write_idata FATAL xdr_t_csip_det_control failed
f_write_idata FATAL failed to write idata
f_etbi_write_idata FATAL xdr_setpos for data block failed
f_etbi_write_idata FATAL failed to lseek file
```

F3.4 ERSI Messages

The ERSI CSU running on three IOP boards in the ESP generates error messages in the form:

ERSI <n> <severity> R: <r> M: <m> S:<s>

where:

<n> = 0,1,2 identifies ESP Input IOP 0, 1 or 2
<severity> = INFO, WARN, FATAL
<r> = Routine number (see below)
<m> = Message number (see below)
<s> = Status word (depends on the routine and message)

Routine #	Function Name
1	main
2	f_ersi_initialize
3	f_ersi_init_parms
4	f_ersi_serve_exec
5	f_ersi_updt_parms
6	f_ersi_get_cpis

Message #	Description
1	failed waiting for input buffer acknowledge
2	invalid data size received in SPB buffer
3	failed while waiting for the sbi to complete
4	failed writing the tpm flags registers to TPM
5	failed filling the output buffer
6	failed to get run parameters
7	failed while waiting for the vme to complete
8	failed to get init parameters
9	exceeded maximum number of tpm boards
10	failed initializing the TPM
11	failed clearing the TPM
12	failed to initialize input handler
13	failed to get cpi data
14	failed during initialization of SPB
15	TPM handling queue alreay full
16	TPM handling queue alreay empty
17	failed waiting for output buffer acknowledge
18	failed waiting for output buffer available

Status word:

Depends on the routine # and message #.

F3.5 EWVU Messages

EWVU (weight vector update calculations) on four PEs are reported in a similar fashion to ERSI messages:

EWVU <n> <severity> R: <r> M: <m> S:<s>

where:

<n> = 0,1,... 7 identifies a weight vector calculation PE
<severity> = INFO, WARN, FATAL
<r> = Routine number (see below)
<m> = Message number (see below)
<s> = Status word (depends on the routine and message)

Routine #	Function Name
1001	main
1002	f_ewvu_init_parms
1003	f_ewvu_serve_exec
1004	f_ewvu_updt_parms
1005	f_ewvu_smple_corrct
1006	f_ewvu_detrmn_systms
1007	f_ewvu_get_snaps
1008	f_ewvu_calc_randr
1009	f_ewvu_cholesky
1010	f_ewvu_backsub_and_put
1011	f_ewvu_upld_weights
1012	f_ewvu_upld_samsig
1013	f_ewvu_upld_snaps
1014	f_ewvu_upld_uandz
1015	f_ewvu_upld_orgsig
1016	f_ewvu_upld_randr

Message #	Description
1002	failed to get init parameters
1003	failed while waiting for the vme to complete
1004	failed while waiting for the sbi to complete
1005	stop processing cmd received from E.C.
1006	failed initializing the TPM
1007	failed clearing the TPM
1008	failed during initialization of SPB
1009	failed to initialize input handler
1010	failed waiting for dsp run command
1011	failed accepting input signal data
1012	failed to get run parameters
1013	failed to get update parameters
1014	failed waiting for a new line of input data
1015	failed filling the output buffer
1016	failed acknowledging input data signal
1017	failed sending input data available signal
1018	exceeded maximum number of tpm boards
1019	invalid swap addressing mode for tpm board
1020	invalid burst size configuration for tpm board
1021	failed while waiting for the download to complete
1022	failed waiting for dsp run or update command
1023	failed to compute new SPB params for NCI burst
1024	failed to send IR parameters
1025	failed while waiting for the upload to complete
1026	failed to update interval parameters
1027	failed waiting for output buffer acknowledge
1028	failed waiting for output buffer available
1029	failed waiting for input buffer acknowledge
1030	failed waiting for input buffer available
1031	invalid data size received in SPB buffer

1032	failed filling the line buffer
1033	failed to upload IR for RSP input
1034	failed writing the tpm flags registers to TPM
1035	got a bad configuration, no phase centres
1036	got a bad configuration, invalid config entry
1037	got a bad configuration, snaps per interval is zero
1038	got a bad configuration, all snaps rejected
1039	TPM handling queue alreay full
1040	TPM handling queue alreay empty

Status word:

Depends on routine and message numbers.

F3.6 ESIG Messages

ESIG (ESP signal processing and weighted summation) runs on 32 PEs and reports routine and message numbers as follows:

ESIG <n> <severity> R: <r> M: <m> S:<s>

where:

<n> = 0,1,... 31 identifies a weighted-sum calculation PE
<severity> = INFO, WARN, FATAL
<r> = Routine number (see below)
<m> = Message number (see below)
<s> = Status word (depends on the routine and message)

Routine #	Function Name
2001	main
2002	f_esig_init_parms
2003	f_esig_serve_exec
2004	f_esig_updt_parms
2005	f_esig_nulling
2006	f_esig_blanking
2007	f_esig_masr_dpca
2008	f_esig_freq_align
2009	f_esig_pulse_doppler
2010	f_esig_upld_nulsig
2011	f_esig_upld_blnk_sig
2012	f_esig_upld_post_masr
2013	f_esig_upld_freq_align
2014	f_esig_upld_pulse_dop
2015	f_esig_initialize

Message #	Description
2002	failed to get run parameters
2003	failed while waiting for the vme to complete
2004	failed to get init parameters
2005	exceeded maxmum number of tpm
2006	failed to wait sbi completion
2007	failed initializating tpm
2008	failed clearing tpm
2009	failed waiting for sbi completion
2010	failed initialization
2011	computed n_pd less than PD_FFT_len
2012	failed waiting for output buffer acknowledge
2013	failed waiting for output buffer available
2014	TPM handling queue alreay full
2015	TPM handling queue alreay empty

Status word:

Depends on routine and message number.

F3.7 ERSO Messages

ERSO runs on the two output IOPs and reports routine and message numbers as follows:

ERSO <n> <severity> R: <r> M: <m> S:<s>

where:

<n> = 0,1 identifies an ESP Output IOP
<severity> = INFO, WARN, FATAL
<r> = Routine number (see below)
<m> = Message number (see below)
<s> = Status word (depends on the routine and message)

Routine #	**Function Name**
3001	main
3002	f_erso_initialize
3003	f_erso_init_parms
3004	f_erso_serve_exec
3005	f_erso_updt_parms
3006	f_erso_xfer_cpis

Message #	**Description**
3001	failed to initialize output handler
3002	failed waiting for input buffer available
3003	failed to set output buffer full
3004	failed to send signal service request to E.C.
3005	failed while waiting for the sbi to complete
3006	failed writing the tpm flags registers to TPM
3007	send host event that iteration is complete
3008	failed while waiting for the vme to complete
3009	failed to get input data from TPM buffer
3010	failed to get init parameters
3011	exceeded maximum number of tpm boards
3012	failed clearing the TPM
3013	failed during initialization of SPB
3014	failed initializing the TPM
3015	failed to get run parameters
3016	failed to transfer data to RSP
3017	TPM handling queue alreay full
3018	TPM handling queue alreay empty
3019	failed waiting for output buffer acknowledge
3020	failed waiting for output buffer available

Status word:

Depends on routine and message number.

F3.8 EUTL Messages

ESP utility errors may be reported from any of the ESP IOPs or GSPs. They are identified by the 4000-level routine and message numbers, listed as follows:

Routine #	**Function Name**
4001	f_eutl_burst_ops
4002	f_eutl_upld_idata

Message #	**Description**
4001	failed waiting for input buffer available
4002	invalid data size received in SPB buffer
4003	failed while waiting for the sbi to complete
4004	failed writing the tpm flags registers to TPM
4005	failed filling output buffer
4006	failed to get run parameters
4007	failed while waiting for the vme to complete
4008	failed to get init parameters
4009	exceeded maximum number of tpm boards
4010	failed initializing the TPM
4011	failed clearing the TPM
4012	failed to initialize
4013	failed to get cpi data
4014	failed during initialization of SPB
4015	TPM handling queue alreay full
4016	TPM handling queue alreay empty
4017	failed waiting for output buffer acknowledge
4018	failed waiting for output buffer available
4019	failed to send I.R. data to E.C.

Status word:

Depends on routine and message number.

F4. RSP MESSAGES

RSP messages originate from two sources:

1. Executive Controller CSUs: RMGR, RCON, RDDH and RIRH
2. VASP PE CSUs: RINP, RPCP, RNCI, RDET

Similar to the ESP, the general format of RSP errors is:

<function> <severity> <message>

RSP messages do not have a time stamp for RSP Executive Controller messages:

<function> = f_rmgr, f_rcon, f_rddh, f_rirh

<severity> = INFO, WARN, FATAL

<message> = Informational messages listed below (sections B4.1 to B4.4)

For ESP PE errors:

<function> =

```
INP <i>              (i = 0,1 identifies an input IOP)
PCP <j>              (j = 0,1,...35  is a pulse compression PE)
NCI <k>              (k = 0,1,...,7  is a NCIs PE)
DET <l>              (l = 0,1,2,3  is a detection PE)
```

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F4.1 RMGR Messages

Messages orginating from the RSP Manager CSU include the following:

```
f_rmgr_main FATAL Failed to initialize status/error log file
f_rmgr_main FATAL Failed to initialize RMGR-Testbed Controller interface
f_rmgr_main FATAL Failed to initialize PE-RSP Manager interface
f_rmgr_main FATAL Unable to spawn task rirh
f_rmgr_main FATAL Unable to spawn task rddh
f_rmgr_main FATAL Unable to create task watchdog timer
f_rmgr_main INFO RSP Manager is ready.
f_rmgr_main FATAL Returned from f_rmgr_wait_for_cmd
f_rmgr_main WARN Failed to delete error/status log file from logTask
f_rmgr_init_log FATAL Couldn't open status/error file
f_rmgr_init_log FATAL Failed to add status/error log_file_fd to logTask
f_rmgr_init_log FATAL Failed to create run semaphore
f_rmgr_init_rpc FATAL Failed to create RPC server tcp transport handle
f_rmgr_init_rpc FATAL Failed to register RPC server with OS
f_rmgr_init_log FATAL Could not install VASP driver
f_rmgr_init_log FATAL Failed to open event flag table
f_rmgr_init_log FATAL Failed to create g_rmgr_error_msgQ
f_rmgr_init_log FATAL Failed to connect msg-Q to VAI driver
f_rmgr_init_vai FATAL Failed to create VAI response msg-Q
f_rmgr_init_vai FATAL Failed to create VAI dataSR msg-Q
f_rmgr_init_vai FATAL Failed to connect event flag entry to dataSR queue
f_rmgr_init_vai FATAL Failed to open RSP configuration file
f_rmgr_install_vai FATAL Create IOP subassembly failed
f_rmgr_install_vai FATAL Create IOP PE failed
f_rmgr_install_vai FATAL Create GSP subassembly failed
f_rmgr_install_vai FATAL Create GSP PCP PE failed
f_rmgr_install_vai FATAL Create GSP NCI PE failed
f_rmgr_install_vai FATAL Create GSP DET PE failed
f_rmgr_open_PEs FATAL Failed to write to PE
f_rmgr_open_PEs FATAL Failed to get response from a PE
f_rmgr_rest_VASP FATAL Failed to reset IOP 1
f_rmgr_reset_VASP FATAL Failed to reset GSP board
f_rmgr_reset_VASP FATAL Failed to reset IOP 2
f_rmgr_close_PEs FATAL Failed to write to PE
f_rmgr_wait_for_cmd FATAL Select failed
f_rmgr_handle_serv_req FATAL Could not decode stage from PE devUsage in dsr
f_rmgr_handle_serv_req FATAL Failed to download DI set to PE stage
f_rmgr_handle_serv_req FATAL Invalid error severity code returned from PE
f_rmgr_handle_serv_req FATAL Invalid error severity code returned from RDDH task
f_rmgr_handle_serv_req FATAL Invalid error severity code returned from RIRH task
f_rmgr_handle_serv_req FATAL Unkown error detected in g_rmgr_error_msgQ
f_rmgr_load_PE_code FATAL Failed to close PE file descriptors
f_rmgr_load_PE_code FATAL Failed to reset VASP boards
f_rmgr_load_PE_code FATAL Failed to open PEs
f_rmgr_load_pe_code FATAL Could not open image file
f_rmgr_load_pe_code FATAL Could not determine status of PE image
f_rmgr_load_pe_code FATAL Could not allocate memory for PE image
f_rmgr_load_pe_code FATAL Could not read PE image
f_rmgr_load_pe_code FATAL Could not load INP image to PE
f_rmgr_load_pe_code FATAL Could not load PCP image to PE
f_rmgr_load_pe_code FATAL Could not load NCI image to PE
f_rmgr_load_pe_code FATAL Could not load DET image to PE
f_rmgr_load_pe_code FATAL Could not receive from PE
f_rmgr_load_pe_code FATAL Cannot download
f_rmgr_load_pe_code FATAL Download failed
f_rmgr_load_pe_code FATAL Could not receive data service request from PE
f_rmgr_load_pe_code FATAL Did not receive an init request from a PE: PE is
out-of-sequence
f_rmgr_load_pe_code FATAL Could not decode stage from PE devUsage string in dsr
f_rmgr_load_pe_code FATAL Could not write to PE
f_rmgr_load_pe_code FATAL Could not receive init_parameter response from PE
f_rmgr_updte_params WARN Failed to send update command to PEs
f_rmgr_update_params WARN Failed to receive data service request from PE
f_rmgr_update_params FATAL Could not decode stage from PE devUsage string in dsr
f_rmgr_update_params FATAL Invalid hostEventFlag received
f_rmgr_update_params FATAL Could not write to PE
f_rmgr_update_params WARN Failed to receive response from PE
f_rmgr_update_params WARN Failed to download DI set to PE stage
f_rmgr_run_cmd WARN Failed to send RUN command to RIRH
f_rmgr_run_cmd FATAL Could not take semaphore g_rmgr_run_sem
f_rmgr_run_cmd WARN Failed to send RUN command to RDDH
f_rmgr_run_cmd FATAL Error returned from f_rmgr_send_run_cmd_to_PEs
```

```
f_rmgr_stop_cmd FATAL Error returned from f_rmgr_send_cmd_to_PEs
f_rmgr_stop_cmd WARN Failed to send STOP command to RIRH
f_rmgr_stop_cmd FATAL Could not take semaphore g_rmgr_run_sem
f_rmgr_stop_cmd WARN Failed to send STOP command to RDDH
f_rmgr_send_cmd_to_PEs FATAL Invalid command received
f_rmgr_send_cmd_to_PEs FATAL Failed to send command to INP PE
f_rmgr_send_cmd_to_PEs FATAL Failed to receive response from PE
f_rmgr_send_cmd_to_PEs FATAL Failed to send command to PCP PE
f_rmgr_send_cmd_to_PEs FATAL Failed to send command to NCI PE
f_rmgr_send_cmd_to_PEs FATAL Failed to send command to DET PE
f_rmgr_send_run_cmd_to_PEs WARN Failed to send run command to DET PE
f_rmgr_send_run_cmd_to_PEs WARN Failed to receive response from a DET PE
f_rmgr_send_run_cmd_to_PEs WARN Failed to send run command to NCI PE
f_rmgr_send_run_cmd_to_PEs WARN Failed to receive response from a NCI PE
f_rmgr_send_run_cmd_to_PEs WARN Failed to send run command to PCP PE
f_rmgr_send_run_cmd_to_PEs WARN Failed to receive response from a PCP PE
f_rmgr_send_run_cmd_to_PEs WARN Failed to send run command to INP PE
f_rmgr_send_run_cmd_to_PEs WARN Failed to receive response from a INP PE
f_rmgr_terminate_wait_for_cmd WARN Failed to send STOP command to RIRH
f_rmgr_terminate_wait_for_cmd WARN Failed to send STOP command to RDDH
f_rmgr_terminate_wait_for_cmd WARN Failed to send DSP unit error message to Testbed
controller
f_rmgr_download_DI_set FATAL Could not write GET to PE
f_rmgr_download_DI_set FATAL Could not receive response from PE
f_rmgr_download_DI_set FATAL Invalid pe_stage
f_rmgr_download_DI_set FATAL Could not read next DI parameters from PE
f_rmgr_download_DI_set FATAL Could not write next di parameters to PE
f_rmgr_download_DI_set FATAL Could not receive response from PE
f_rmgr_download_DI_set FATAL Could not write to PE
f_rmgr_create_log_file FATAL Couldn't open a new status/error file
f_rmgr_create_log_file WARN Failed to add status/error log_file_fd to logTask
f_rmgr_remove_log_file WARN  Failed to delete error/status log file from logTask
f_rmgr_dispatch FATAL Received NULL server name
f_rmgr_dispatch FATAL Failed to get command from Testbed Controller
f_rmgr_dispatch INFO received command
f_rmgr_dispatch FATAL Error returned from f_rmgr_create_log_file
f_rmgr_dispatch FATAL Failed to download PE sw images from EC to PE
f_rmgr_dispatch FATAL Failed to compute number of RSP channels
f_rmgr_dispatch FATAL Failed to compute the Pulse Compression FFT in a DI instance
f_rmgr_dispatch FATAL Failed to compute number of buffers pipelined in TPM and its
size
f_rmgr_dispatch FATAL Failed to compute CFAR threshold multiplier for DET stage
f_rmgr_dispatch FATAL Failed to compute Monopulse params for DET stage
f_rmgr_dispatch FATAL Failed to compute ASAR Outer flag for DET stage
f_rmgr_dispatch WARN 1st capt_post_CC flag is TRUE although # of CC channels = 0
f_rmgr_dispatch WARN This flag will be set FALSE
f_rmgr_dispatch WARN 2nd capt_post_CC flag is TRUE although # of CC channels = 0
f_rmgr_dispatch WARN This flag will be set FALSE
f_rmgr_dispatch FATAL Failed to download RSP processing parameters to PEs
f_rmgr_dispatch INFO Now sending run cmd to PEs
f_rmgr_dispatch FATAL Failed to issue run cmd to RDDH/RIRH/or PEs
f_rmgr_dispatch WARN Received Configure/Update command while RSP Manager was already
in RUN state
f_rmgr_dispatch FATAL Failed to create g_cl_mgr client handle
f_rmgr_dispatch FATAL Failed to send command completion acknowledge to Testbed
Controller
f_rmgr_dispatch FATAL Error returned from f_rmgr_create_log_file
f_rmgr_dispatch FATAL Failed to send Run command PEs, or RDDH/RIRH tasks
f_rmgr_dispatch WARN Received Run command before receiving Configure or Update command
f_rmgr_dispatch WARN RSP Manager will ignore Run command and remain in Ready state
f_rmgr_dispatch FATAL Failed to send Run command PEs, or RDDH/RIRH tasks
f_rmgr_dispatch WARN Received Run command while RSP Manager was already in RUN state
f_rmgr_dispatch FATAL Failed to send Stop command PEs, or RDDH/RIRH tasks
f_rmgr_dispatch FATAL Error returned from f_rmgr_remove_log_file
f_rmgr_dispatch WARN Received Stop command while RSP Manager was already in READY
state
f_rmgr_dispatch FATAL Failed to reset VASP boards
f_rmgr_dispatch WARN Received an invalid command from TestBed
f_rmgr_dispatch INFO Now in default of switch (svc->...
```

F4.2 RCON Messages

Messages originating from RSP signal processing configuration (RCON) may include the following:

Messages:

```
f_rcon_channels FATAL Invalid DPCA/doppler blankers combination selected
f_rcon_channels FATAL Invalid DPCA combination selected
f_rcon_num_augmented WARN Number Doppler augmented cells exceeded total Doppler cells
f_rcon_num_augmented WARN Clamping to total Doppler bins = %d
f_rcon_PC_FFT_len FATAL PC FFT length exceeds maximum of 1024
f_rcon_PC_FFT_len WARN PC FFT length less than 32
f_rcon_PC_FFT_len WARN Assuming 32 point FFT
f_rcon_bursts_piped FATAL Not enough memory in PCP dwell %d
f_rcon_bursts_piped FATAL Requires %d longwords
f_rcon_bursts_piped FATAL max_burst_size = 0!
f_rcon_bursts_piped FATAL Check values for _channels, _range_gates, and _vel_bin_pcp
```

F4.3 RDDH Messages

Messages from the RSP Detection Data Handler (RDDH) CSU include the following:

```
f_rddh_main FATAL Error returned from f_rddh_initialize
f_rddh_main FATAL Error returned from f_rddh_wait_for_cmd
f_rddh_initialize FATAL Failed to create VAI response msg-Q
f_rddh_initialize FATAL Failed to create VAI dataSR msg-Q
f_rddh_initialize FATAL Failed to create g_send_dets_sem_ddh
f_rddh_initialize FATAL Could not open qid-event-flag table
f_rddh_initialize FATAL Failed to connect event flag entry to dataSR queue
f_rddh_wait_for_cmd FATAL Failure returned from f_rddh_run_cmd
f_rddh_wait_for_cmd FATAL Failure returned from f_rddh_handle_serv_req
f_rddh_wait_for_cmd FATAL Failure returned from f_rddh_stop_cmd
f_rddh_wait_for_cmd FATAL Failure returned from flushing Response msgQ
f_rddh_wait_for_cmd FATAL Failure returned from flushing Data SR msgQ
f_rddh_run_cmd FATAL Received NULL server name
f_rddh_run_cmd FATAL Could not receive run command from RSP Manager
f_rddh_run_cmd FATAL Failed to create g_cl_ddh client handle
f_rddh_handle_serv_req FATAL Error returned from f_rddh_send_get_to_PE
f_rddh_handle_serv_req FATAL Error returned from f_rddh_read_det_pars_from_PE
f_rddh_handle_serv_req FATAL Invalid dsr received from a PE.
f_rddh_handle_serv_req FATAL DI or NCI identifiers are not identical
f_rddh_handle_serv_req FATAL Error returned from f_rddh_get_nci_detection
f_rddh_stop_cmd FATAL Failed to give g_rmgr_run_sem semaphore
f_rddh_get_nci_detection FATAL Error returned from f_rddh_send_get_to_PE
f_rddh_get_nci_detection FATAL Could not read from PE fd
f_rddh_get_nci_detection FATAL Error returned from f_rddh_send_continue_to_PE
f_rddh_send_continue_to_PE FATAL Could not write c_vutl_vme_upload_complete to PE
f_rddh_send_continue_to_PE FATAL Could not receive response from PE
f_rddh_send_get_to_PE FATAL Could not write GET to PE.
f_rddh_send_get_to_PE FATAL Could not receive response from PE
f_rddh_read_det_pars_from_PE FATAL Could not read from DET PE
f_rddh_send_detection_to_controller FATAL Failed to send DSP detection to Testbed
controller
```

F4.4 RIRH Messages

Messages from the RSP Intermediate Results Handler include the following:

```
f_rirh_main FATAL Error returned from f_rirh_initialize
f_rirh_main FATAL Error returned from f_rirh_wait_for_cmd
f_rirh_wait_for_cmd FATAL Failure returned from f_rirh_run_cmd
f_rirh_wait_for_cmd FATAL Failure returned from f_rirh_handle_serv_req
f_rirh_wait_for_cmd FATAL Failure returned from f_rirh_stop_cmd
f_rirh_wait_for_cmd FATAL Failure returned from flushing Response msgQ
f_rirh_wait_for_cmd FATAL Failure returned from flushing Data SR msgQ
f_rirh_run_cmd FATAL Could not receive run command from RSP Manager
f_rirh_run_cmd FATAL Failed to allocate memory for g_IR_buff_irh
f_rirh_run_cmd FATAL Could not allocate memory for XDR buffer
f_rirh_run_cmd FATAL Error returned from f_rirh_open_IR
f_rirh_run_cmd FATAL Received Stop command -- IRH task out-of-sequence
f_rirh_stop_cmd FATAL Error returned from f_rirh_close_IR
f_rirh_stop_cmd FATAL Failed to give g_rmgr_run_sem semaphore
f_rirh_update_pe_flags FATAL Could not decode stage from PE stage string
f_rirh_send_continue_to_PE FATAL Could not write c_vutl_vme_upload_complete to PE
f_rirh_send_continue_to_PE FATAL Could not receive response from PE
f_rirh_send_get_to_PE FATAL Could not write GET to PE fd
f_rirh_send_get_to_PE FATAL Could not receive response from PE
f_rirh_pe_fd FATAL Could not decode stage from PE stage string
f_rirh_get_IR_pars_from_PE FATAL Error returned from f_rirh_send_get_to_PE
f_rirh_get_IR_pars_from_PE FATAL Could not read IR parameters from INP PE
f_rirh_get_IR_pars_from_PE FATAL Could not read IR parameters from PCP PE
f_rirh_get_IR_pars_from_PE FATAL Could not read from NCI PE
f_rirh_get_IR_pars_from_PE FATAL Invalid pe_stage
f_rirh_get_IR_data_from_PE FATAL Error returned from f_rirh_send_get_to_PE
f_rirh_get_IR_data_from_PE FATAL Could not read from PE fd
f_rirh_open_IR FATAL Failed to open file
f_rirh_open_IR FATAL Failed to create control block
f_rirh_open_IR FATAL Failed to write XDR buffer to file
f_rirh_close_IR FATAL Failed to write header block
f_rirh_close_IR FATAL Failed to close file
f_rirh_build_cntr_blk FATAL Unable to allocate memory for DI elements for product
f_rirh_build_cntr_blk FATAL Unable to allocate memory for NCI elements for product
f_rirh_build_cntr_blk FATAL Unable to allocate memory for CPI elements for product
f_rirh_handle_serv_req FATAL Could not determine interval/product type from dsr.
f_rirh_handle_serv_req FATAL Error returned from f_rirh_pe_fd
f_rirh_handle_serv_req FATAL Error returned from f_rirh_update_pe_flags
f_rirh_handle_serv_req FATAL Invalid dsr received from a PE.
f_rirh_handle_serv_req FATAL Error returned from f_rirh_read_IR_pars_from_PE
f_rirh_handle_serv_req FATAL Failure returned from f_rirh_handle_rsp_input
f_rirh_handle_serv_req FATAL Failure returned from f_rirh_handle_post_pcp
f_rirh_handle_serv_req FATAL Failure returned from f_rirh_handle_post_nci
f_rirh_handle_serv_req FATAL Failure returned from f_rirh_handle_dpca_weights
f_rirh_handle_serv_req FATAL Failure returned from f_rirh_handle_target_deweights
f_rirh_handle_serv_req FATAL Failure returned from f_rirh_handle_pc_replicas
f_rirh_handle_serv_req FATAL Invalid curr_IR_type
f_rirh_handle_rsp_input FATAL Error returned from f_rirh_read_IR_pars_from_PE
f_rirh_handle_rsp_input FATAL Error returned from f_rirh_send_continue_to_PE for PE fd
f_rirh_handle_rsp_input FATAL Error returned from f_rirh_decim_rsp_input for product
f_rirh_handle_rsp_input FATAL Failed to close Intermediate Results files
f_rirh_decim_rsp_input FATAL Error returned from f_rirh_write_XDR_to_file
f_rirh_handle_post_pcp FATAL Error returned from f_rirh_read_IR_pars_from_PE
f_rirh_handle_post_pcp FATAL Error returned from f_rirh_send_continue_to_PE for PE fd
f_rirh_handle_post_pcp FATAL Error returned from f_rirh_decim_post_pc for product
f_rirh_handle_post_pcp FATAL Error returned from f_rirh_decim_post_cc for product
f_rirh_handle_post_pcp FATAL Error returned from f_rirh_decim_monopulse for product
f_rirh_handle_post_pcp FATAL Error returned from f_rirh_decim_post_rcs for product
f_rirh_handle_post_pcp FATAL Error returned from f_rirh_decim_rsp_blanked for product
f_rirh_handle_post_pcp FATAL Wrong index for PCP product
f_rirh_handle_post_pcp FATAL Failed to close Intermediate Results files
f_rirh_decim_post_pc FATAL Error returned from f_rirh_write_XDR_to_file
f_rirh_decim_post_cc FATAL Error returned from f_rirh_write_XDR_to_file
f_rirh_handle_post_nci FATAL Error returned from f_rirh_read_IR_pars_from_PE
f_rirh_handle_post_nci FATAL Error returned from f_rirh_send_continue_to_PE for PE fd
f_rirh_handle_post_nci FATAL Error returned from f_rirh_decim_post_nci for product
f_rirh_handle_post_nci FATAL Failed to close Intermediate Results files
f_rirh_decim_post_nci FATAL Error returned from f_rirh_write_XDR_to_file
f_rirh_decim_post_rcs FATAL Error returned from f_rirh_write_XDR_to_file
f_rirh_decim_rsp_blanked FATAL Error returned from f_rirh_write_XDR_to_file
f_rirh_decim_monopulse FATAL Error returned from f_rirh_write_XDR_to_file
f_rirh_handle_pc_replicas FATAL Error returned from f_rirh_read_IR_pars_from_PE
f_rirh_handle_pc_replicas FATAL Error returned from f_rirh_send_continue_to_PE for PE
fd
f_rirh_handle_pc_replicas FATAL Error returned from f_rirh_write_XDR_to_file
f_rirh_handle_pc_replicas FATAL Failed to close Intermediate Results files
f_rirh_handle_target_deweights FATAL Error returned from f_rirh_read_IR_pars_from_PE
f_rirh_handle_target_deweights FATAL Error returned from f_rirh_send_continue_to_PE
for PE fd
f_rirh_handle_target_deweights FATAL Error returned from f_rirh_write_XDR_to_file
f_rirh_handle_target_deweights FATAL Failed to close Intermediate Results files
f_rirh_handle_dpca_weights FATAL Error returned from f_rirh_read_IR_pars_from_PE
f_rirh_handle_dpca_weights FATAL Error returned from f_rirh_send_continue_to_PE for PE
fd
f_rirh_handle_dpca_weights FATAL Error returned from f_rirh_write_XDR_to_file
f_rirh_handle_dpca_weights FATAL Failed to close Intermediate Results files
```

F4.5 RINP Messages

The RSP Input Handler CSU runs on the two input IOPs and reports errors in the form:

INP <n> <severity> R: <r> M: <m> S: <s>

where:

<n> = 0,1 identifies RSP Input IOP 0 or 1
<severity> = INFO, WARN, FATAL
<r> = Routine number (see below)
<m> = Message number (see below)
<s> = Status word (depends on the routine and message)

Routine #	Function Name
1	main
2	f_rinp_initialize
3	f_rinp_wait_for_cmd
4	f_rinp_accept_data
5	f_rinp_update_intervals
6	f_rinp_upload_output

Message #	Description
2	failed to get init parameters
3	failed while waiting for the vme to complete
4	failed while waiting for the sbi to complete
5	stop processing cmd received from E.C.
6	failed initializing the TPM
7	failed clearing the TPM
8	failed during initialization of SPB
9	failed to initialize input handler
10	failed waiting for dsp run command
11	failed accepting input signal data
12	failed to get run parameters
13	failed to get update parameters
14	failed waiting for a new line of input data
15	failed filling the output buffer
16	failed acknowledging input data signal
17	failed sending input data available signal
18	exceeded maximum number of tpm boards
19	invalid swap addressing mode for tpm board
20	invalid burst size configuration for tpm board
21	failed while waiting for the download to complete
22	failed waiting for dsp run or update command
23	failed to compute new SPB params for NCI burst
24	failed to send IR parameters
25	failed while waiting for the upload to complete
26	failed to update interval parameters
27	failed waiting for output buffer acknowledge
28	failed to signal output buffer available
29	failed waiting for input buffer acknowledge
30	failed to signal input buffer available
31	invalid data size received in SPB buffer
32	failed filling the line buffer
33	failed to upload IR for RSP input
34	failed writing the tpm flags registers to TPM
35	failed to get sim parameters
36	failed to get sim data vector
37	failed to write sim data vector
38	failed to read sim data vector

Valid Error Messages:

```
INP <n> FATAL R: 2 M: 2                          S: <vme_data_serv_req_err>
INP <n> FATAL R: 2 M: 3                          S: 0
INP <n> FATAL R: 2 M: 4                          S: <i_tpm>
INP <n> FATAL R: 2 M: 4                          S: <i_tpm>
INP <n> FATAL R: 2 M: 6                          S: <sbi_init_tpm_err>
INP <n> FATAL R: 2 M: 7                          S: <sbi_fast_pio_write_err>
INP <n> FATAL R: 2 M: 8                          S: <spb_initialize_err>
INP <n> FATAL R: 2 M: 18                         S: <N_tpm>
INP <n> FATAL R: 2 M: <sbi_init_tpm_err>         S: <i_tpm>
INP <n> FATAL R: 2 M: <sbi_fast_pio_write_err>   S: <i_tpm>

INP <n> FATAL R: 3 M: 3                          S: 0
INP <n> FATAL R: 3 M: 12                         S: <vme_data_serv_req_err>

INP <n> FATAL R: 4 M: 15                         S: 0
INP <n> FATAL R: 4 M: 15                         S: <sbi_fast_pio_write_err>
INP <n> FATAL R: 4 M: 16                         S: 0
INP <n> FATAL R: 4 M: 16                         S: <spb_rx_check_buf_full_err>
INP <n> FATAL R: 4 M: 27                         S: <tpm_flags_status>
INP <n> FATAL R: 4 M: 28                         S: <tpm_flags_status>
INP <n> FATAL R: 4 M: 31                         S: <lw_rcvd>

INP <n> FATAL R: 5 M: 3                          S: <m_pack_interval>
INP <n> FATAL R: 5 M: 13                         S: <vme_data_serv_req_err>
INP <n> FATAL R: 5 M: 21                         S: <m_pack_interval>
INP <n> FATAL R: 5 M: 23                         S: <m_pack_interval>

INP <n> FATAL R: 6 M: 3                          S: <nv>
INP <n> FATAL R: 6 M: 4                          S: <nv>
INP <n> FATAL R: 6 M: 24                         S: <vme_data_serv_req_err>
INP <n> FATAL R: 6 M: 25                         S: <nv>
INP <n> FATAL R: 6 M: 32                         S: <sbi_fast_pio_read_err>
INP <n> FATAL R: 6 M: <sbi_fast_pio_read_err>    S: <nv>
```

where,

<n> = Input IOP number (0,1)
<N_tpm> = Number of TPM boards in RSP input stage, maximum is 2
<i_tpm> = Current TPM board number, [0,1]
<lw_rcvd> = Number of longwords received in SPB buffer, maximum is 4094
<nv> = Current Doppler bin number, [0..(N_v_b-1)]

See section F5 for list of SBI, TPM, SPB and VME message and status codes.

F4.6 RPCP Messages

RSP pulse compression PEs report exception conditions in the form:

PCP <n> <severity> R: <r> M: <m> S: <s>

where:

<n> = 0,1, ..., 35 is the PE number (9 GSP x 4 PE/GSP)
<severity> = INFO, WARN, FATAL
<r> = Routine number (see below)
<m> = Message number (see below)
<s> = Status word (depends on the routine and message)

Routine #	Function Name
1001	main
1002	f_rpcp_initialize
1003	f_rpcp_wait_for_cmd
1004	f_rpcp_run_state
1005	f_rpcp_update_di_set
1006	f_rpcp_match_filter
1007	f_rpcp_deweight_thres
1008	f_rpcp_read_signals
1009	f_rpcp_process
1010	f_rpcp_write_signals
1011	f_rpcp_upload_output
1012	f_rpcp_pulse_comp
1013	f_rpcp_asar_dpca
1014	f_rpcp_monopulse
1015	f_rpcp_square_mag
1016	f_rpcp_range_doppler_blank
1017	f_rpcp_augment_line
1018	f_rpcp_aug_convolve
1019	f_rpcp_mono_argument
1020	f_rpcp_window
1021	f_rpcp_bessel_i0
1022	f_rpcp_tuned_index
1023	f_rpcp_update_di

Message #	Description
1002	failed to get init parameters
1003	failed while waiting for the vme to complete
1004	failed while waiting for the sbi to complete
1005	stop processing cmd received from E.C.
1006	failed initializing the TPM
1007	failed clearing the TPM
1008	failed to initialize input handler
1009	failed waiting for dsp run command
1010	failed processing signal data during run
1011	failed to get run parameters
1012	failed to get update parameters
1013	failed filling the output buffer
1014	exceeded maximum number of tpm boards
1015	invalid swap addressing mode for tpm board
1016	invalid burst size configuration for tpm board
1017	failed while waiting for the download to complete
1018	failed waiting for dsp run or update command
1019	failed to send IR parameters
1020	failed while waiting for the upload to complete
1021	failed to update interval parameters
1022	failed waiting for output buffer acknowledge
1023	failed to signal output buffer available
1024	failed waiting for input buffer available
1025	failed to signal input buffer acknowledge

1026	failed writing the tpm flags registers to TPM
1027	failed to upload the PC replicas to E.C.
1028	failed to read the input data signals from TPM
1029	failed to signal input acknowledge to next stage
1030	failed to process signal data in stage
1031	failed to write processed signal data to TPM
1032	failed to signal output available to next stage
1033	failed to compute new match filter coefficients
1034	failed filling the line buffer
1035	failed to upload the PC output to E.C.
1036	failed to upload the CC output to E.C.
1037	failed to upload the monopulse output to E.C.
1038	failed to upload the rcs output to E.C.
1039	failed to upload the RSP blanked output to E.C.

Status word:

Same format as in RINP but different in routine numbers, message numbers and status words.

F4.7 RNCI Messages

RSP non-coherent integration PEs messages have the form:

NCI <n> <severity> R: <r> M: <m> S: <s>

where:

<n> = 0,1, ..., 7 is the PE number (2 GSP x 4 PE/GSP)
<severity> = INFO, WARN, FATAL
<r> = Routine number (see below)
<m> = Message number (see below)
<s> = Status word (depends on the routine and message)

Routine #	Function Name
2001	main
2002	f_rnci_initialize
2003	f_rnci_wait_for_cmd
2004	f_rnci_run_state
2005	f_rnci_update_di_set
2006	f_rnci_read_signals
2007	f_rnci_process
2008	f_rnci_write_signals
2009	f_rnci_upload_output
2010	f_rnci_doppler_shift
2011	f_rnci_range_shift
2012	f_rnci_vel_align
2013	f_rnci_sa_trwc
2014	f_rnci_linear
2015	f_rnci_order_stats
2016	f_rnci_update_di
2017	f_rnci_update_nci

Message #	Description
2002	failed to get init parameters
2003	failed while waiting for the vme to complete
2004	failed while waiting for the sbi to complete
2005	stop processing cmd received from E.C.
2006	failed initializing the TPM
2007	failed clearing the TPM
2008	failed to initialize input handler
2009	failed waiting for dsp run command
2010	failed processing signal data during run
2011	failed to get run parameters
2012	failed to get update parameters
2013	failed filling the output buffer
2014	exceeded maximum number of tpm boards
2015	invalid swap addressing mode for tpm board
2016	invalid burst size configuration for tpm board
2017	failed while waiting for the download to complete
2018	failed waiting for dsp run or update command
2019	failed to send IR parameters
2020	failed while waiting for the upload to complete
2021	failed to update interval parameters
2022	failed waiting for output buffer acknowledge
2023	failed to signal output buffer available
2024	failed to signal input buffer acknowledge
2025	failed waiting for input buffer available
2026	failed writing the tpm flags registers to TPM
2027	failed to upload the NCI burst to E.C.
2028	failed to read the input data signals from TPM
2029	failed to process signal data in stage
2030	failed to write processed signal data to TPM
2031	failed to compute new doppler shift

2032	failed filling the data workspace
2033	exceeded number of CPI bursts to integrated
2034	exceeded data workspace
2035	rank depth is zero
2036	new value of rank depth

Status word:

Same format as in RINP but different in routine numbers, message numbers and status words.

F4.8 RDET Messages

RSP detection PEs messages have the form:

DET <n> <severity> R: <r> M: <m> S: <s>

where:

<n> = 0,1,2,3 is the detection PE number (1 GSP x 4 PE/GSP)
<severity> = INFO, WARN, FATAL
<r> = Routine number (see below)
<m> = Message number (see below)
<s> = Status word (depends on the routine and message)

Routine #	Function Name
3001	main
3002	f_rdet_initialize
3003	f_rdet_wait_for_cmd
3004	f_rdet_run_state
3005	f_rdet_read_signals
3006	f_rdet_update_di_set
3007	f_rdet_process
3008	f_rdet_upload_output
3009	f_rdet_fixed
3010	f_rdet_cell_avg
3011	f_rdet_order_stats
3012	f_rdet_form_detection
3013	f_rdet_update_di
3014	f_rdet_update_nci

Message #	Description
3002	failed to get init parameters
3003	failed while waiting for the vme to complete
3004	failed while waiting for the sbi to complete
3005	stop processing cmd received from E.C.
3006	failed initializing the TPM
3007	failed clearing the TPM
3008	failed to initialize input handler
3009	failed waiting for dsp run command
3010	failed processing signal data during run
3011	failed to get run parameters
3012	failed to get update parameters
3013	failed filling the output buffer
3014	exceeded maximum number of tpm boards
3015	invalid swap addressing mode for tpm board
3016	invalid burst size configuration for tpm board
3017	failed while waiting for the download to complete
3018	failed waiting for dsp run or update command
3019	failed to send IR parameters
3020	failed while waiting for the upload to complete
3021	failed to update interval parameters
3022	failed waiting for output buffer acknowledge
3023	failed to signal output buffer available
3024	failed to signal input buffer acknowledge
3025	failed waiting for input buffer available
3026	failed writing the tpm flags registers to TPM
3027	invalid pe number assigned to PE
3028	failed to read the input data signals from TPM
3029	failed to process signal data in stage
3030	failed to write processed signal data to TPM
3031	failed filling the data workspace
3032	invalid detector type assigned
3033	failed to send detections to E.C.

3034	failed to get the monopulse angle from TPM buffer
3035	exceeded data workspace

Status word:

Same format as in RINP but different in routine numbers, message numbers and status words.

F5. VASP SUPPORT SOFTWARE COMMON MESSAGE CODES

The VASP PE Support Software (PESS) and PE utilities (UTLPE) software return status words which indicate success or the nature of a failure, for example, in a call to software drivers which transfer data to TPM, SPB, or the VME bus. The following lists the common return status and return codes.

<tpm_flags_status> :

2	TPM_FLAG_SET_e
1	TPM_FLAGS_ALL_SET_e
0	TPM_OWNER_e
-1	TPM_FLAG_ALREADY_SET_e
-2	TPM_NOT_OWNER_e

<m_pack_interval> :

S = (10000 * current DI number) +
(1000 * current NCI number) +
(current CPI number)

F5.1 PESS Message Codes

The following lists exception conditions in calls to the PESS drivers for VME bus (vme_...), Signal Bus interface (sbi_...), Synchronous Parallel bus (spb_...), and Event Flags (ef_...). The following message codes may be reported from any DSP or RTSG CSU which calls a PESS function.

Message #	Description
<vme_signal_serv_req_err>	
7002	queue overflow returned by VME_signal_serv_req_f
7003	range error returned by VME_signal_serv_req_f
<vme_error_serv_req_err>	
7004	queue overflow returned by VME_error_serv_req_f
7005	range error returned by VME_error_serv_req_f
<vme_data_serv_req_err>	
7006	queue overflow returned by VME_data_serv_req_f
7007	range error returned by VME_data_serv_req_f
<sbi_init_tpm_err>	
7101	timeout returned by SBI_init_TPM_f
7102	range error returned by SBI_init_TPM_f
7103	range error returned by SBI_init_TPM_f
<sbi_semaphore_increment_err>	
7104	parity error returned by SBI_semaphore_increment_f
7105	timeout returned by SBI_semaphore_increment_f
7106	range error returned by SBI_semaphore_increment_f
7107	queue full error returned by SBI_semaphore_increment_f
<sbi_single_write_err>	
7108	timeout returned by SBI_single_write_f
7109	range error returned by SBI_single_write_f
7110	queue full error returned by SBI_single_write_f
<sbi_dma_write_err>	
7111	timeout returned by SBI_DMA_write_f
7112	range error returned by SBI_DMA_write_f
7113	queue full error returned by SBI_DMA_write_f
7114	burst error returned by SBI_DMA_write_f
7115	burst cycle error returned by SBI_DMA_write_f
<sbi_fast_pio_write_err>	
7116	timeout returned by SBI_fast_PIO_write_f
7117	range error returned by SBI_fast_PIO_write_f
7118	queue full error returned by SBI_fast_PIO_write_f
7119	burst error returned by SBI_fast_PIO_write_f
7120	burst cycle error returned by SBI_fast_PIO_write_f
<sbi_single_read_err>	
7121	parity error returned by SBI_single_read_f
7122	timeout returned by SBI_single_read_f
7123	range error returned by SBI_single_read_f
7124	queue full error returned by SBI_single_read_f
<sbi_dma_read_err>	
7125	parity error returned by SBI_DMA_read_f
7126	timeout returned by SBI_DMA_read_f
7127	range error returned by SBI_DMA_read_f
7128	queue full error returned by SBI_DMA_read_f
7129	burst error returned by SBI_DMA_read_f
7130	burst cycle error returned by SBI_DMA_read_f
<sbi_fast_pio_read_err>	
7131	timeout returned by SBI_fast_PIO_read_f
7132	range error returned by SBI_fast_PIO_read_f
7133	queue full error returned by SBI_fast_PIO_read_f
7134	burst error returned by SBI_fast_PIO_read_f
7135	burst cycle error returned by SBI_fast_PIO_read_f
7136	parity error returned by SBI_fast_PIO_read_f

```
<sbi_signal_tpm_flags_err>
 7137          timeout error returned by SBI_signal_tpm_flags_f
 7138          range error returned by SBI_signal_tpm_flags_f
 7139          queue full error returned by SBI_signal_tpm_flags_f
 7140          parity error returned by SBI_signal_tpm_flags_f

<sbi_test_tpm_flags_err>
 7141          timeout error returned by SBI_test_tpm_flags_f
 7142          range error returned by SBI_test_tpm_flags_f
 7143          queue full error returned by SBI_test_tpm_flags_f
 7144          parity error returned by SBI_test_tpm_flags_f

<spb_initialize_err>
 7201          range error returned by SPB_initialize_f
 7202          no clock error returned by SPB_initialize_f

<spb_tx_check_buf_empty_err>
 7203          range error returned by SPB_tx_check_buf_empty_f
 7204          wrong mode returned by SPB_tx_check_buf_empty_f

<spb_tx_set_buf_full_err>
 7205          range error returned by SPB_tx_set_buf_full_f
 7206          wrong mode returned by SPB_tx_set_buf_full_f

<spb_rx_check_buf_full_err>
 7207          range error returned by SPB_rx_check_buf_full_f
 7208          wrong mode returned by SPB_rx_check_buf_full_f
 7209          data overrun error returned by SPB_rx_check_buf_full_f
 7210          no clock error returned by SPB_rx_check_buf_full_f

<spb_rx_set_buf_empty_err>
 7211          range error returned by SPB_rx_set_buf_empty_f
 7212          wrong mode returned by SPB_rx_set_buf_empty_f
 7213          data overrun error returned by SPB_rx_set_buf_empty_f
 7214          no clock error returned by SPB_rx_set_buf_empty_f

<ef_test_and_clear_err>
 7301          range error returned by EF_test_and_clear_f

<ef_set_timer_err>
 7302          range error returned by EF_set_timer_f

<ef_mask_pe_pe_err>
 7303          range error returned by EF_mask_pe_pe_f

<ef_set_pe_pe_err>
 7304          range error returned by EF_set_pe_pe_f
 7305          timeout error returned by EF_set_pe_pe_f
```

F5.2 UTLPE Message Codes

The following message codes are reserved for PE utility routines. These may reported in any VASP PE CSU which calls a PE utility function. Message codes are as follows:

Message #	Description
7401	data overrun error
7402	loop count =
7403	initialization parameters received
7404	failed while trying to get initialization parameters
7405	processing parameters received
7406	failed while trying to get processing parameters
7407	input buffer full signal received
7408	stop processing signal received
7409	failed checking for stop processing signal
7410	failed while waiting for stop processing
7411	failed during initialization
7412	encountered unknown error condition
7413	failed clearing all event flags
7414	number of tpm, out of range
7415	TPM 1 base address out of range
7416	TPM 2 base address out of range

APPENDIX G

PARAMETER ESTIMATION HMI

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APPENDIX G

PARAMETER ESTIMATION HMI

G1. INTRODUCTION

This Appendix illustrates the graphical interface dialogues in the Range Ambiguity Resolution/Parameter Estimation (RAR/PE) function which is used to process DSP detection data into unambiguous target of range and speed estimates.

The graphical version of RAR/PE is run from PVWave Command Language and makes use of the graphical user interface features in WaveCL. The RAR/PE HMI is started in Wave CL with the commands *@init_rar* followed by *x=computer( ).*

The following describes each HMI dialogue and its parameters. The procedure for running RAR/PE is described in Section 3 of the body of this Operator's Manual.

G1.1 Parameter Estimation Dialogue Hierarchy

Figure G-1 illustrates the hierarchy of dialogues in the RAR/PE HMI. The "Data Selection" dialogue forms the top-level dialogue and is used to access lower-level dialogues. To ensure proper selection of dwell and "M" in M of N, the lower level dialogues should be accessed in order of: 1) Detection File, 2) Root Specifier, and 3) Dwell Select.

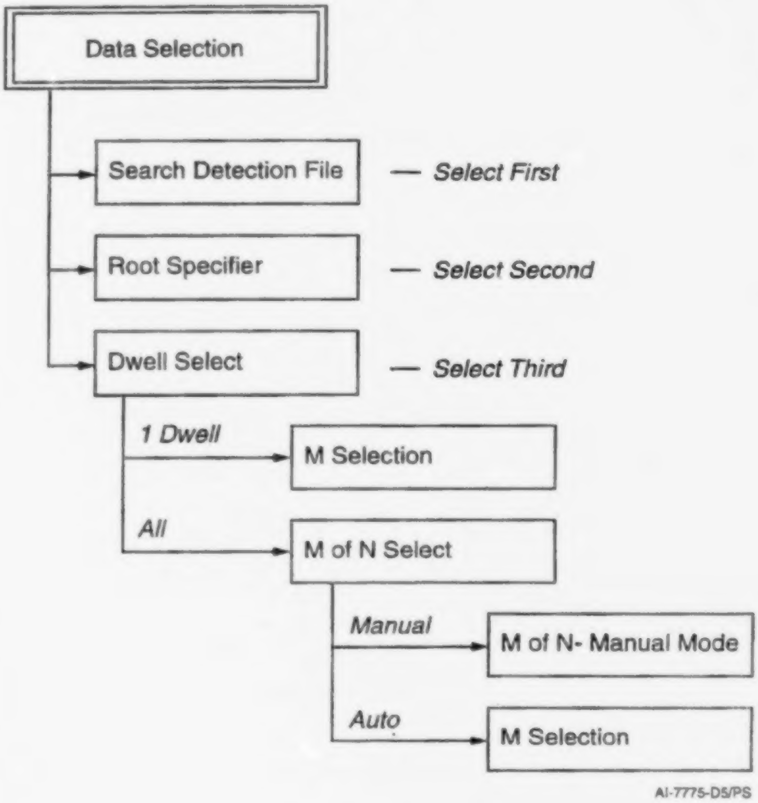

Data Selection
Search Detection File
— Select First
Root Specifier
— Select Second
Dwell Select
— Select Third
1 Dwell
M Selection
All
M of N Select
Manual
M of N- Manual Mode
Auto
M Selection
AI-7775-D5/PS

Figure G-1 Parameter Estimation Hierarchy Diagram

G2. PARAMETER ESTIMATION

G2.1 Data Selection (Top-Level) Dialogue

This is the top-level dialogue (Figure G-2) provided in RAR/PE. It is opened when the RAR/PE function is invoked by the command: *x=compute ( )*. This dialogue provides access to three lower-level dialogues as follows:

Icon	Opens Dialogue
Input File Select	Search Detection File
Output Root File Select	Root Specifier
Dwell Select	Dwell Select

The "M Selection" dialogue is opened automatically after selecting the dwell.

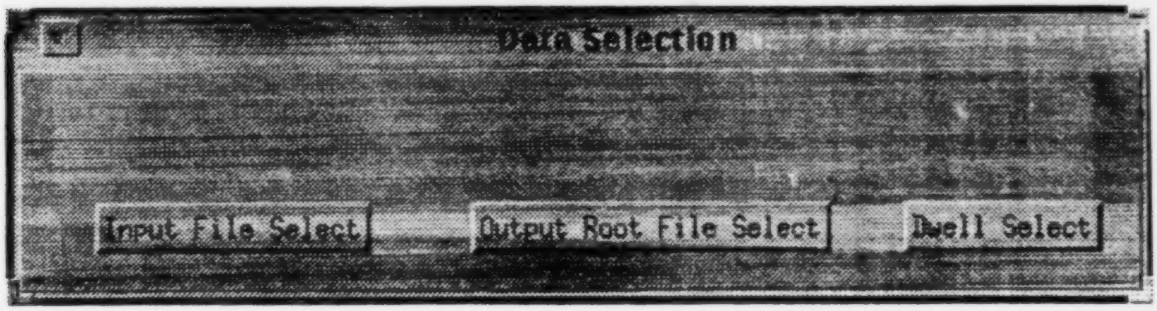

Data Selection
Input File Select
Output Root File Select
Dwell Select

Figure G-2 Data Selection Dialogue

G2.2 Search Detection File

This dialogue (Figure G-3) is used to select the DSP detection data file that will be processed by RAR/PE. The file filler is set to the default extension for detection data: **.dt.detection*. The filename may be typed in or selected by selecting the file under "Files". Use "OK" to confirm the selection and exit this dialogue.

The "M Selection" dialogue is opened automatically after selecting the dwell.

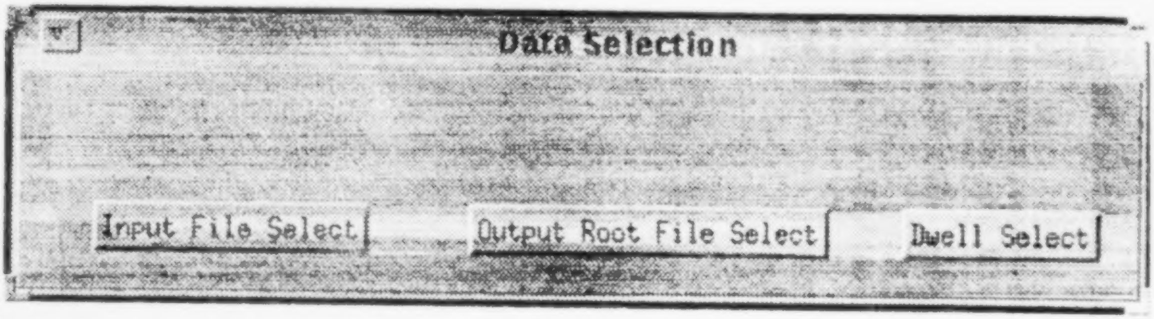
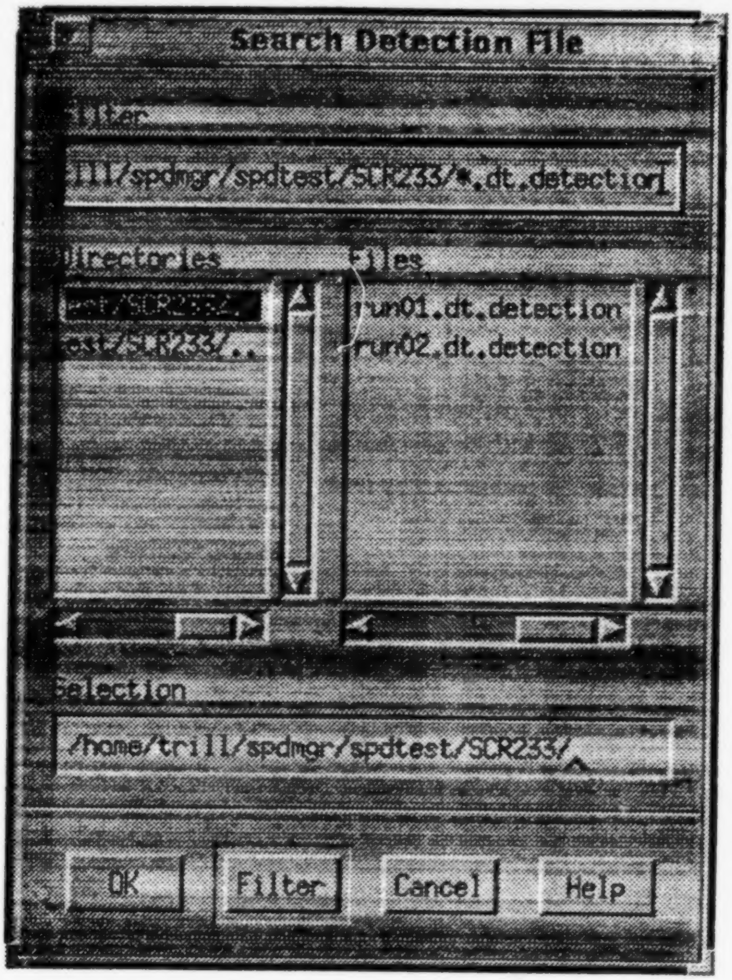

Data Selection
Input File Select
Output Root File Select
Dwell Select

Figure G-2 Data Selection Dialogue

G2.2 Search Detection File

This dialogue (Figure G-3) is used to select the DSP detection data file that will be processed by RAR/PE. The file filler is set to the default extension for detection data: **.dt.detection*. The filename may be typed in or selected by selecting the file under "Files". Use "OK" to confirm the selection and exit this dialogue.



ill/spdmgr/spdtest/SCR233/*.dt.detectio

est/SCR233/.
est/SCR233/..

run01.dt.detection
run02.dt.detection

/home/trill/spdmgr/spdtest/SCR233/

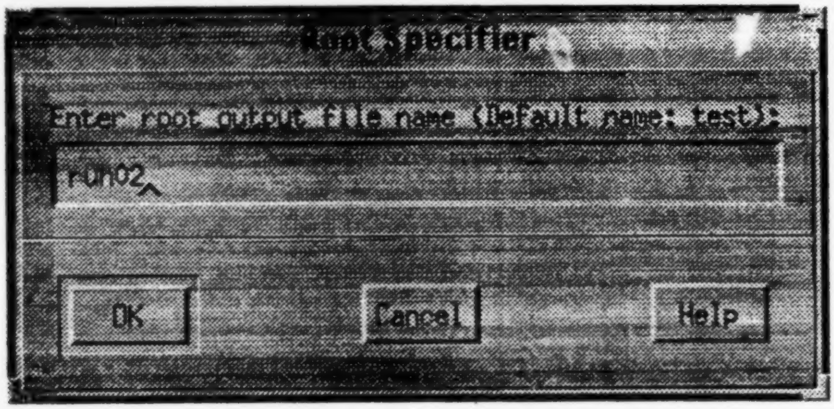
Figure G-3 Search Detection File Dialogue

G2.3 Root Specifier

This dialogue (Figure G-4) is used to specify a "root" or "prefix" name for the output file of RAR/PE. It is reached from the top-level Data Selection dialogue by selecting "Output Root File Select".

Any alphanumeric characters that form a valid Unix filename may be used. A prefix that relates to the Simulation Run identifier (e.g., "run02") is recommended.

The RAR output will be written to a filename: *<rootname>_<dwellnum>*, where *<rootname>* is the root output file name specified in this dialogue, and *<dwellnum>* is the dwell number, selected in "Dwell Select".



Enter root output file name (Default name: test):

run02

Figure G-4 Root Specifier Dialogue

G2.4 Dwell Select

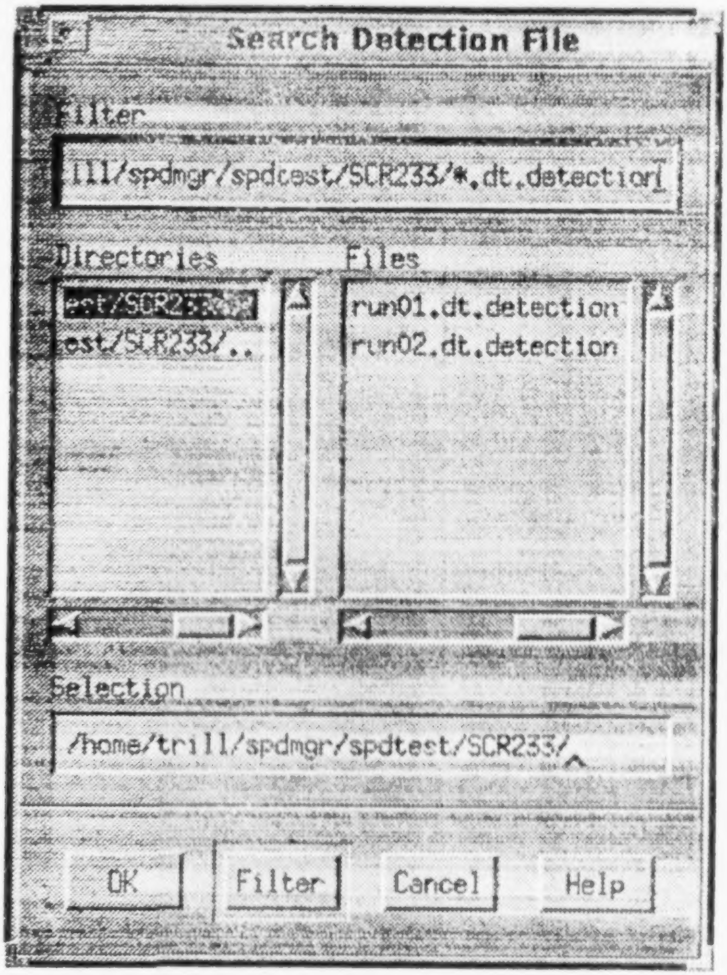
This dialogue (Figure G-5) is used to specify the dwell to process in the detection data. It is reached from the top-level Data Selection dialogue by selecting "Dwell Select".

Number of Dwells Available indicates the total number of dwells of detection data in the selected detection data file. The detection data must first be selected.

Dwell Number is used to graphically select the desired dwell out of those available, counting from 1 upwards. To accept this value, the "Accept Slider" button must be selected.

Accept Slider/Select All is a pair of radio buttons which are used to select either the dwell number indicated on the slider bar, or to enable processing of all dwells in the detection data.

To use this dialogue, first select "Accept Slider" or "All" and then enter the dwell number if "Accept Slider" is chosen. Clicking "OK" will confirm the selection and pop up the appropriate subdialogues.



Filter: ill/spdmgr/spdtest/SCR233/*.dt.detection

Directories:
- est/SCR233/.
- est/SCR233/..

Files:
- run01.dt.detection
- run02.dt.detection

Selection: /home/trill/spdmgr/spdtest/SCR233/

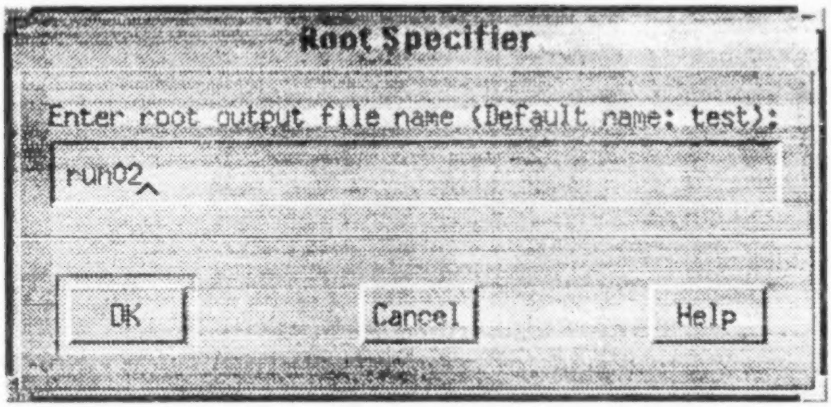
Figure G-3 Search Detection File Dialogue

G2.3 Root Specifier

This dialogue (Figure G-4) is used to specify a "root" or "prefix" name for the output file of RAR/PE. It is reached from the top-level Data Selection dialogue by selecting "Output Root File Select".

Any alphanumeric characters that form a valid Unix filename may be used. A prefix that relates to the Simulation Run identifier (e.g., "run02") is recommended.

The RAR output will be written to a filename: *<rootname>_<dwellnum>*, where *<rootname>* is the root output file name specified in this dialogue, and *<dwellnum>* is the dwell number, selected in "Dwell Select".



Enter root output file name (Default name: test):

run02

Figure G-4 Root Specifier Dialogue

G2.4 Dwell Select

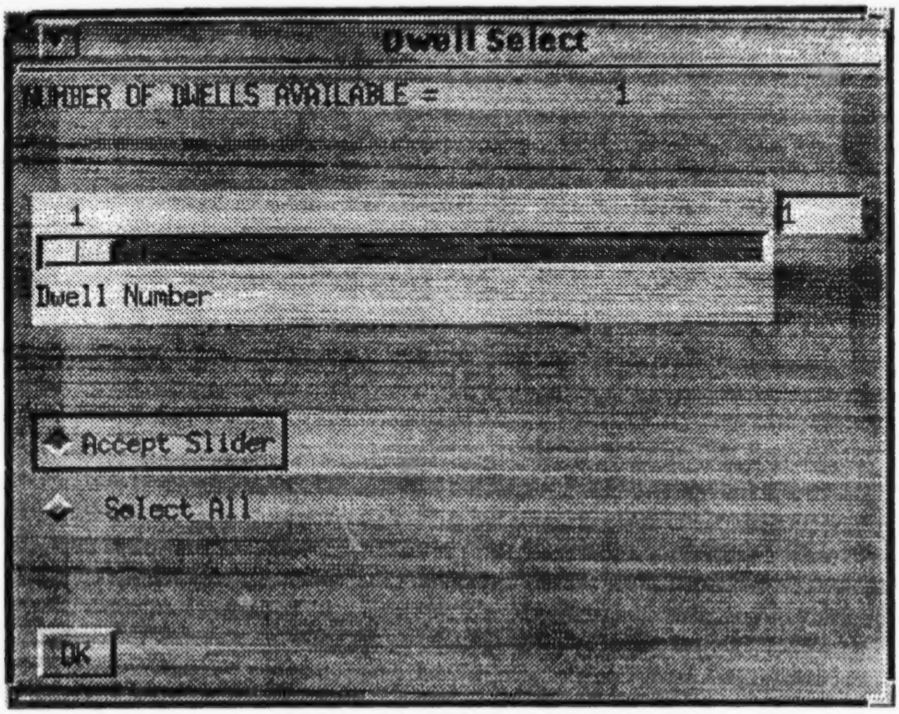
This dialogue (Figure G 5) is used to specify the dwell to process in the detection data. It is reached from the top-level Data Selection dialogue by selecting "Dwell Select".

Number of Dwells Available indicates the total number of dwells of detection data in the selected detection data file. The detection data must first be selected.

Dwell Number is used to graphically select the desired dwell out of those available, counting from 1 upwards. To accept this value, the "Accept Slider" button must be selected.

Accept Slider/Select All is a pair of radio buttons which are used to select either the dwell number indicated on the slider bar, or to enable processing of all dwells in the detection data.

To use this dialogue, first select "Accept Slider" or "All" and then enter the dwell number if "Accept Slider" is chosen. Clicking "OK" will confirm the selection and pop up the appropriate subdialogues.



NUMBER OF DWELLS AVAILABLE = 1

Figure G-5 Dwell Select Dialogue

G2.4.1 M Selection (One Dwell)

This subdialogue (Figure G-6) is used to specify the "M" value for M of N RAR if one dwell is selected. This dialogue pops up from the Dwell Select dialogue if "Accept Slider" and a dwell number are specified.

This subdialogue indicates "N", the total number of NCIs in the dwell that will be used for RAR/PE. The user-entered value of "M" may be any integer from 1 to N. Hit return to accept the value and exit this subdialogue.

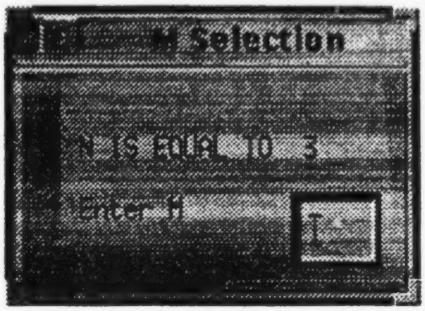


Figure G-6 M Selection Dialogue

G2.4.2 M of N Select (All Dwells)

If "Select All" is chosen in the Dwell Select Dialogue, this subdialogue (Figure G-7) is popped up to provide two choices in the selection of "M":

1) Manual Mode
2) Automatic Mode.

Clicking on one or the other will access the next subdialogue level.

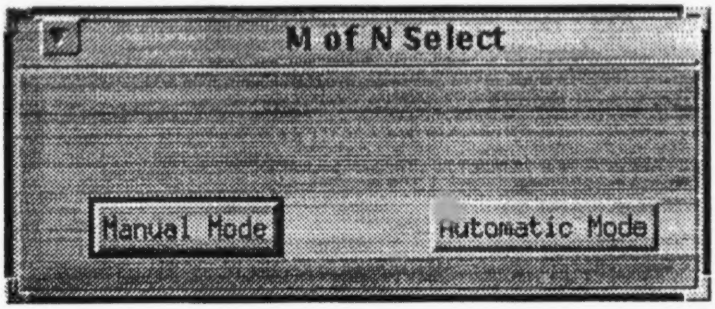


Figure G-7 M of N Select Dialogue (All Dwells)

G2.4.2.1 M of N - Manual Mode

This subdialogue (Figure G-8) allows selection of unique M for each dwell processed. This dialogue is accessed by selecting "Manual Mode" from the "M of N Select" subdialogue.

This dialogue lists all the dwells in the detection data along with the number of NCIs (N) in each. The user selects an integer value of M (in the range 1 to N) for each, and then clicks "OK" to confirm the selection and exit the subdialogue. Figure G-8 illustrates an

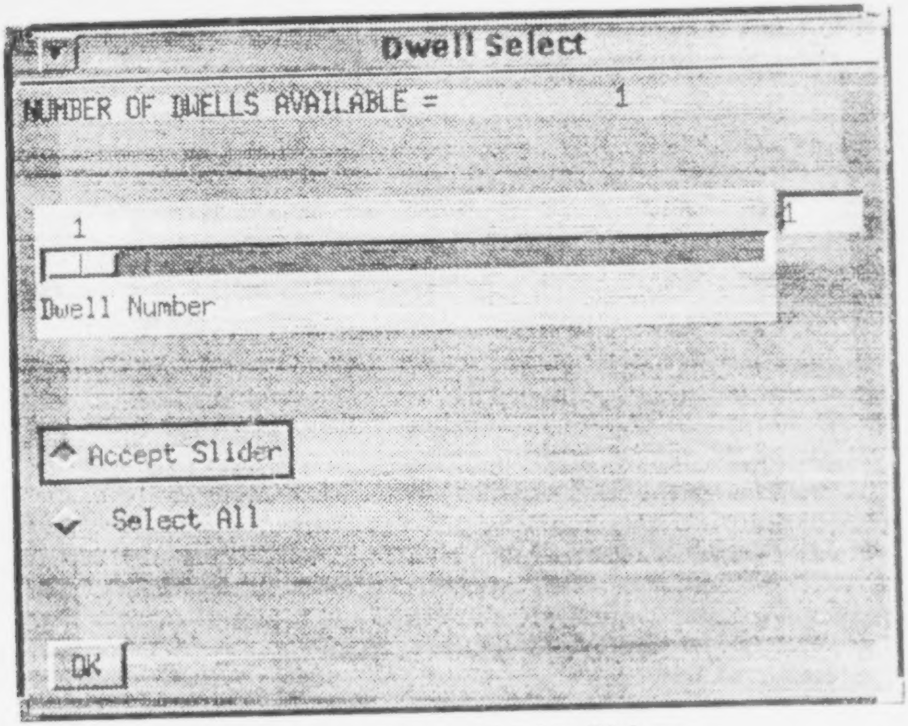
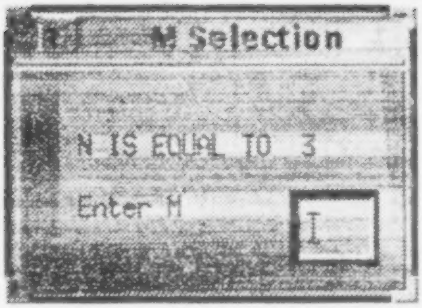

NUMBER OF DWELLS AVAILABLE = 1

Figure G-5 Dwell Select Dialogue

G2.4.1 M Selection (One Dwell)

This subdialogue (Figure G-6) is used to specify the "M" value for M of N RAR if one dwell is selected. This dialogue pops up from the Dwell Select dialogue if "Accept Slider" and a dwell number are specified.

This subdialogue indicates "N", the total number of NCIs in the dwell that will be used for RAR/PE. The user-entered value of "M" may be any integer from 1 to N. Hit return to accept the value and exit this subdialogue.



M Selection

N IS EQUAL TO 3

Enter M

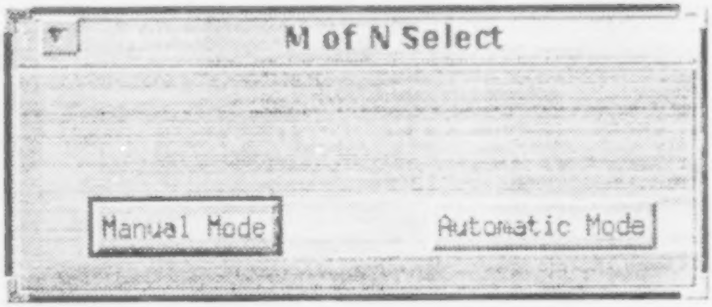
Figure G-6 M Selection Dialogue

G2.4.2 M of N Select (All Dwells)

If "Select All" is chosen in the Dwell Select Dialogue, this subdialogue (Figure G-7) is popped up to provide two choices in the selection of "M":

1) Manual Mode
2) Automatic Mode.

Clicking on one or the other will access the next subdialogue level.



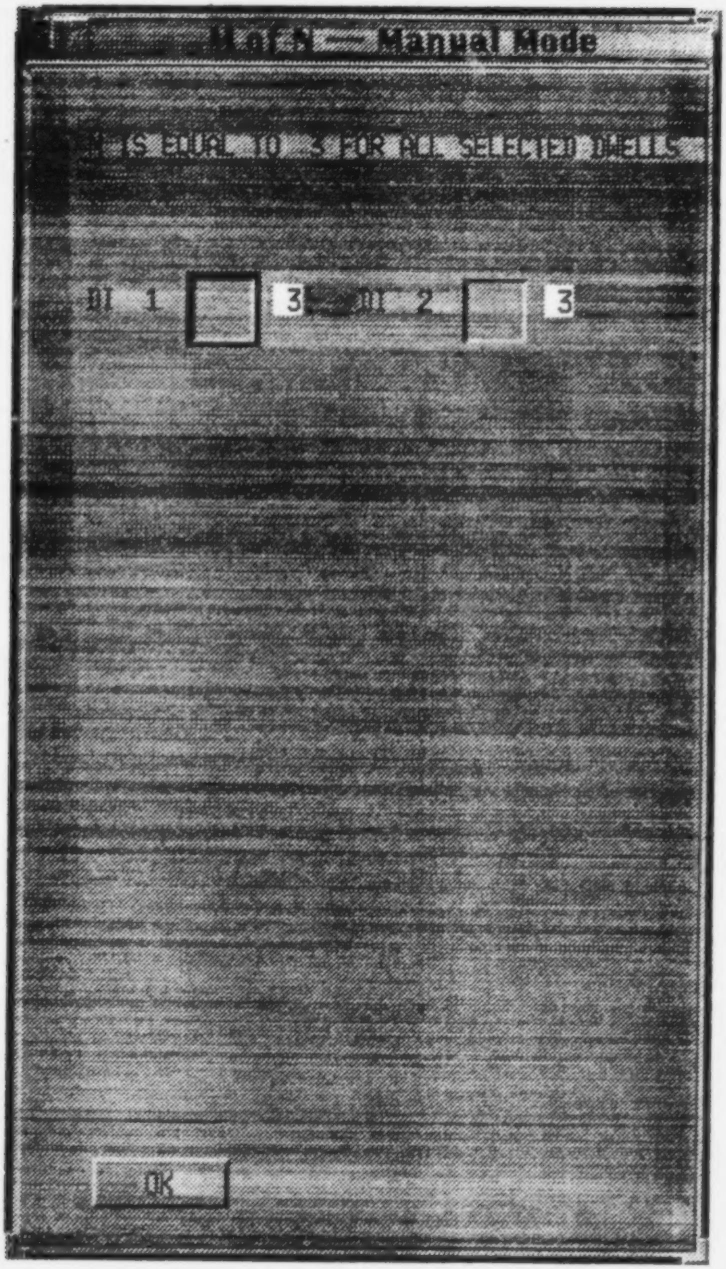
M of N Select

Figure G-7 M of N Select Dialogue (All Dwells)

G2.4.2.1 M of N - Manual Mode

This subdialogue (Figure G-8) allows selection of unique M for each dwell processed. This dialogue is accessed by selecting "Manual Mode" from the "M of N Select" subdialogue.

This dialogue lists all the dwells in the detection data along with the number of NCIs (N) in each. The user selects an integer value of M (in the range 1 to N) for each, and then clicks "OK" to confirm the selection and exit the subdialogue. Figure G-8 illustrates an example of two dwells, each with 3 NCIs/dwell.


M of N — Manual Mode
DI 1
3
DI 2
3
OK

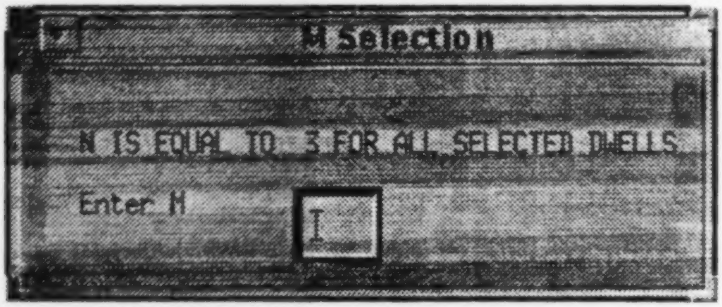
M IS EQUAL TO 3 FOR ALL SELECTED DWELLS

Figure G-8 M of N - Manual Mode Subdialogue

G2.4.2.2 M Selection (All Dwells - Automatic Mode)

This subdialogue (Figure G-9) allows selection of one value of M for all dwells processed. This dialogue is accessed by selecting "Automatic Mode" from the "M of N Select" subdialogue.

This dialogue indicates the number of NCIs/dwell (N) in the dwells to be processed. One value of M in the range 1 to N is user-entered, and confirmed by hitting return.



N IS EQUAL TO 3 FOR ALL SELECTED DWELLS

Enter M

Figure G-9 M Selection Subdialogue (Automatic Mode)

G3. EXAMPLE OUTPUTS

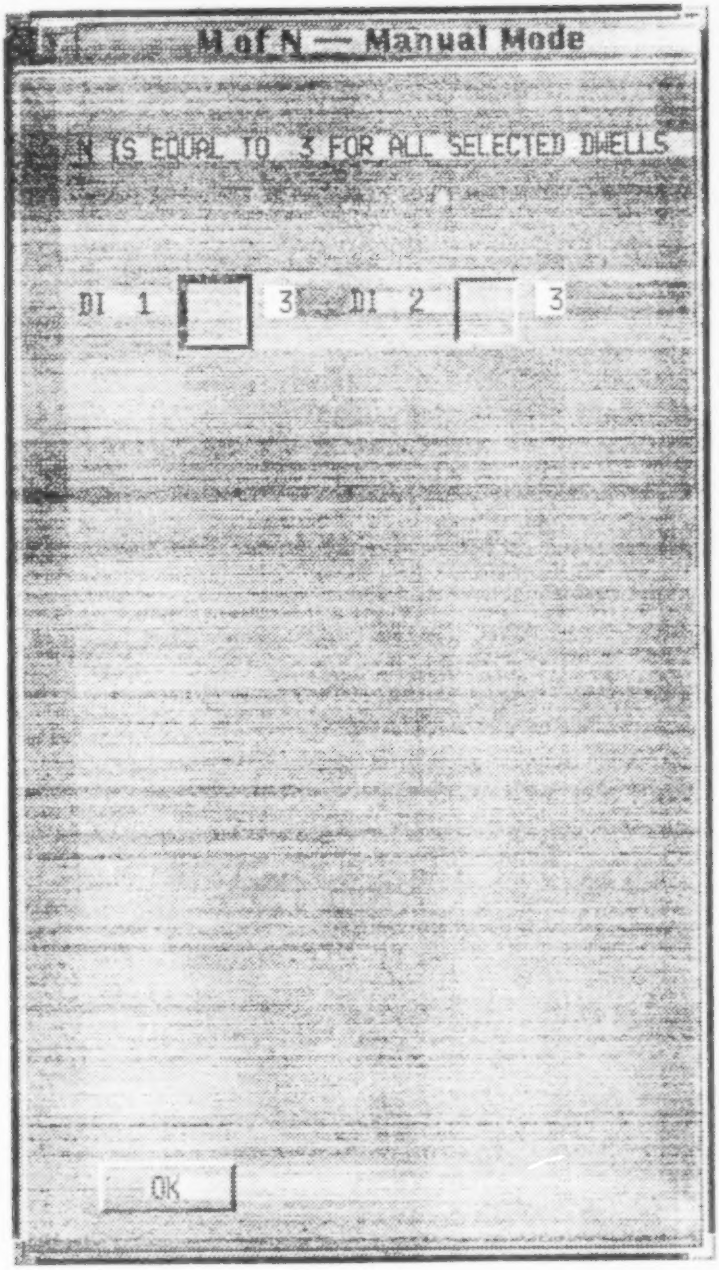
The RAR/PE function generates two forms of output:

- Graph of target speed vs unambiguous range;
- ASCII debug output of target parameters.

G3.1 Speed Vs Range Graph

Figure G-10 illustrates an example of graphical output from RAR/PE consisting of target speed plotted against unambiguous resolved range, plotted for one dwell. In this example (taken from system test results), there were 3 targets approaching the SBR and one receding. In the unambiguous results, these are visible in the form of 3 clusters of target "hits" with a positive radial speed component (approaching), and one negative speed cluster (receding).

example of two dwells, each with 3 NCIs/dwell.


M of N — Manual Mode
DI 1
3
DI 2
3
OK

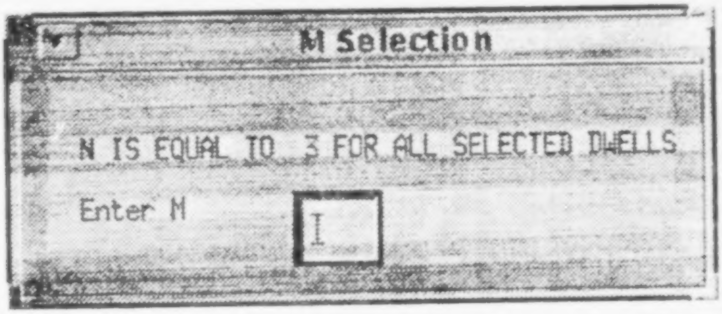
N IS EQUAL TO 3 FOR ALL SELECTED DWELLS

Figure G-8 M of N - Manual Mode Subdialogue

G2.4.2.2 M Selection (All Dwells - Automatic Mode)

This subdialogue (Figure G-9) allows selection of one value of M for all dwells processed. This dialogue is accessed by selecting "Automatic Mode" from the "M of N Select" subdialogue.

This dialogue indicates the number of NCIs/dwell (N) in the dwells to be processed. One value of M in the range 1 to N is user-entered, and confirmed by hitting return.



M Selection

N IS EQUAL TO 3 FOR ALL SELECTED DWELLS

Enter M

Figure G-9 M Selection Subdialogue (Automatic Mode)

G3. EXAMPLE OUTPUTS

The RAR/PE function generates two forms of output:

- Graph of target speed vs unambiguous range;
- ASCII debug output of target parameters.

G3.1 Speed Vs Range Graph

Figure G-10 illustrates an example of graphical output from RAR/PE consisting of target speed plotted against unambiguous resolved range, plotted for one dwell. In this example (taken from system test results), there were 3 targets approaching the SBR and one receding. In the unambiguous results, these are visible in the form of 3 clusters of target "hits" with a positive radial speed component (approaching), and one negative speed cluster (receding).

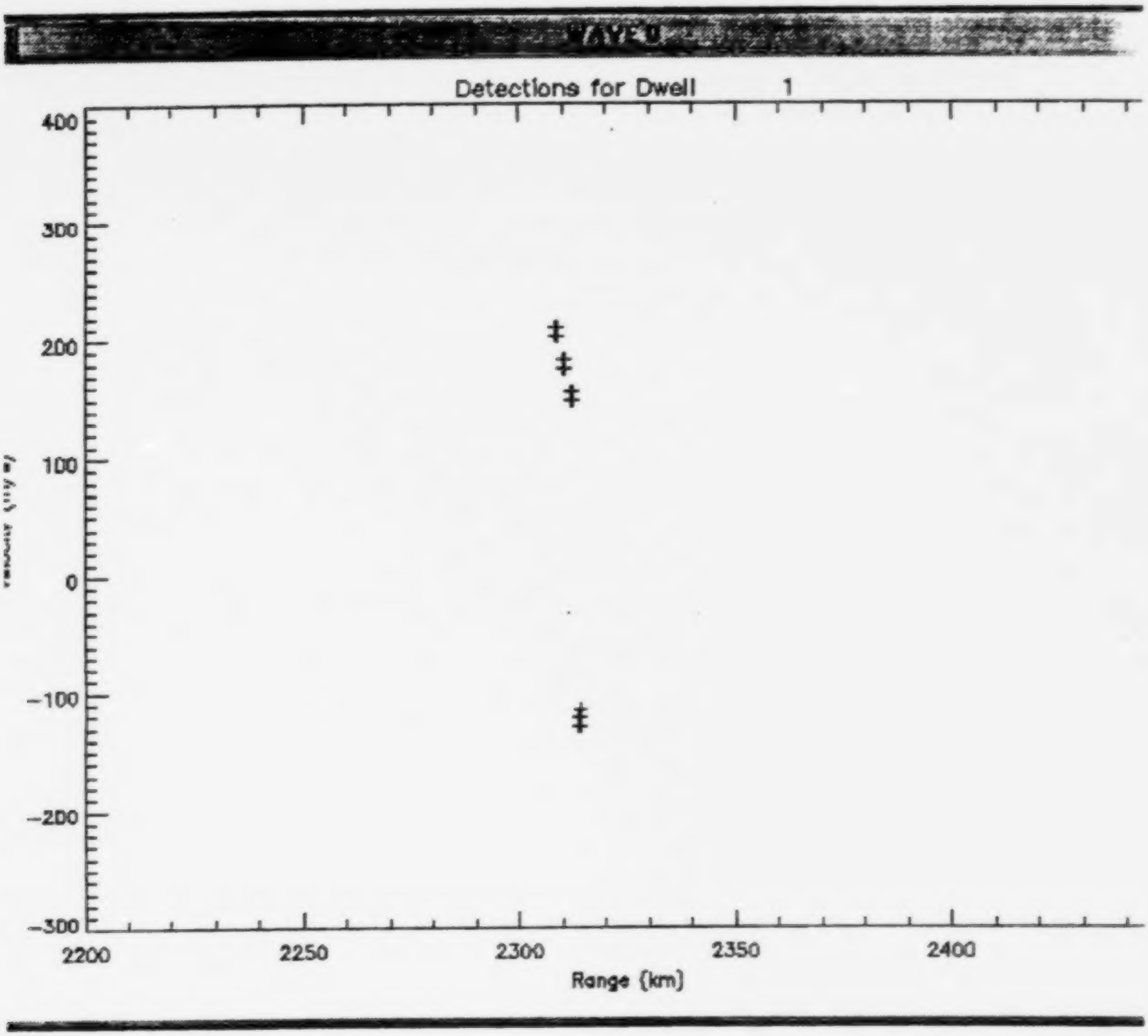
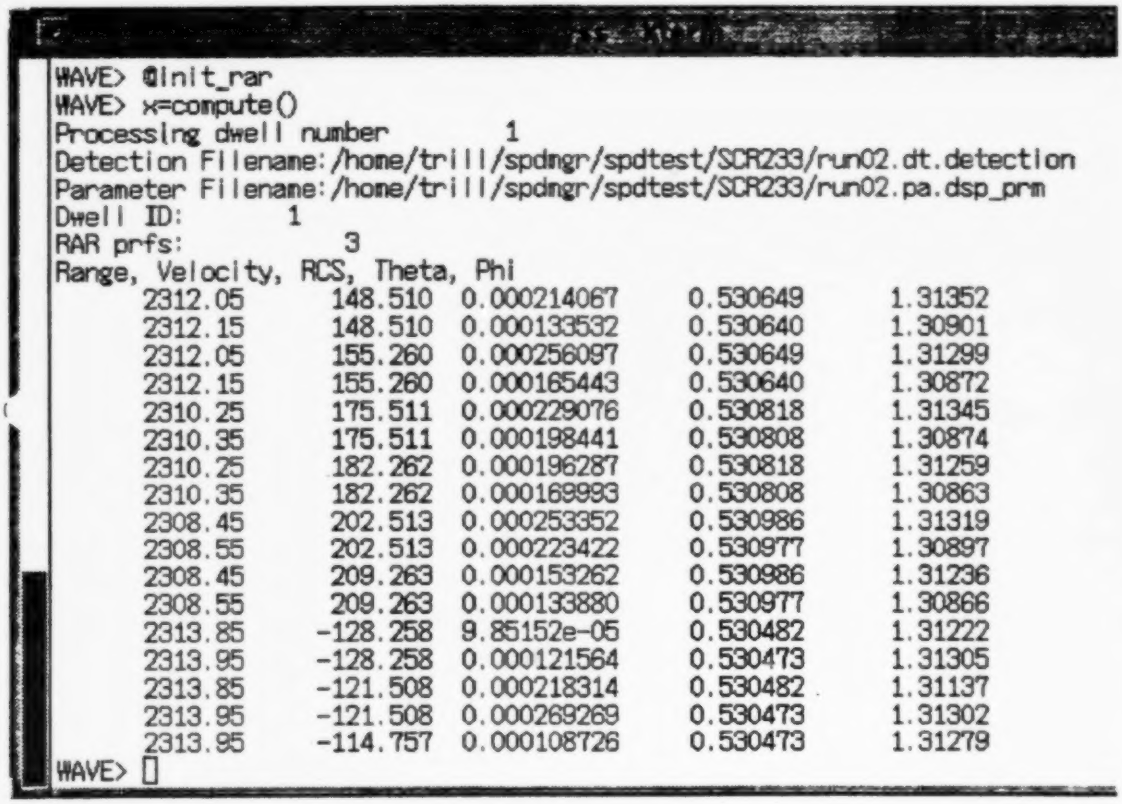


Figure G-10 Plot of Target Speed Vs Unambiguous Range

G3.2 Target Parameters Output

Numerical estimates of target parameters are generated by RAR/PE and printed in ASCII format in the window in which PVWave is running. Figure G-11 illustrates the target data that was plotted in Figure G-10.



```
WAVE> @init_rar
WAVE> x=compute()
Processing dwell number        1
Detection Filename:/home/trill/spdmgr/spdtest/SCR233/run02.dt.detection
Parameter Filename:/home/trill/spdmgr/spdtest/SCR233/run02.pa.dsp_prm
Dwell ID:       1
RAR prfs:           3
Range, Velocity, RCS, Theta, Phi
       2312.05       148.510  0.000214067      0.530649       1.31352
       2312.15       148.510  0.000133532      0.530640       1.30901
       2312.05       155.260  0.000256097      0.530649       1.31299
       2312.15       155.260  0.000165443      0.530640       1.30872
       2310.25       175.511  0.000229076      0.530818       1.31345
       2310.35       175.511  0.000198441      0.530808       1.30874
       2310.25       182.262  0.000196287      0.530818       1.31259
       2310.35       182.262  0.000169993      0.530808       1.30863
       2308.45       202.513  0.000253352      0.530986       1.31319
       2308.55       202.513  0.000223422      0.530977       1.30897
       2308.45       209.263  0.000153262      0.530986       1.31236
       2308.55       209.263  0.000133880      0.530977       1.30866
       2313.85      -128.258  9.85152e-05      0.530482       1.31222
       2313.95      -128.258  0.000121564      0.530473       1.31305
       2313.85      -121.508  0.000218314      0.530482       1.31137
       2313.95      -121.508  0.000269269      0.530473       1.31302
       2313.95      -114.757  0.000108726      0.530473       1.31279
WAVE> □
```

Figure G-11 Target Parameters Output Table

The following parameters are printed:

- **Dwell ID** indicates the dwell number counting from 1;
- **RAR PRFs** indicates the number of NCIs used to resolve unambiguous range (value of M in M of N).

For each resolved range/Doppler "hit":

- **Range** is the resolved target range in km;
- **Velocity** is the target radial velocity computed from the Doppler bin;
- **RCS** is a numerical value proportional to the estimated target radar cross section;

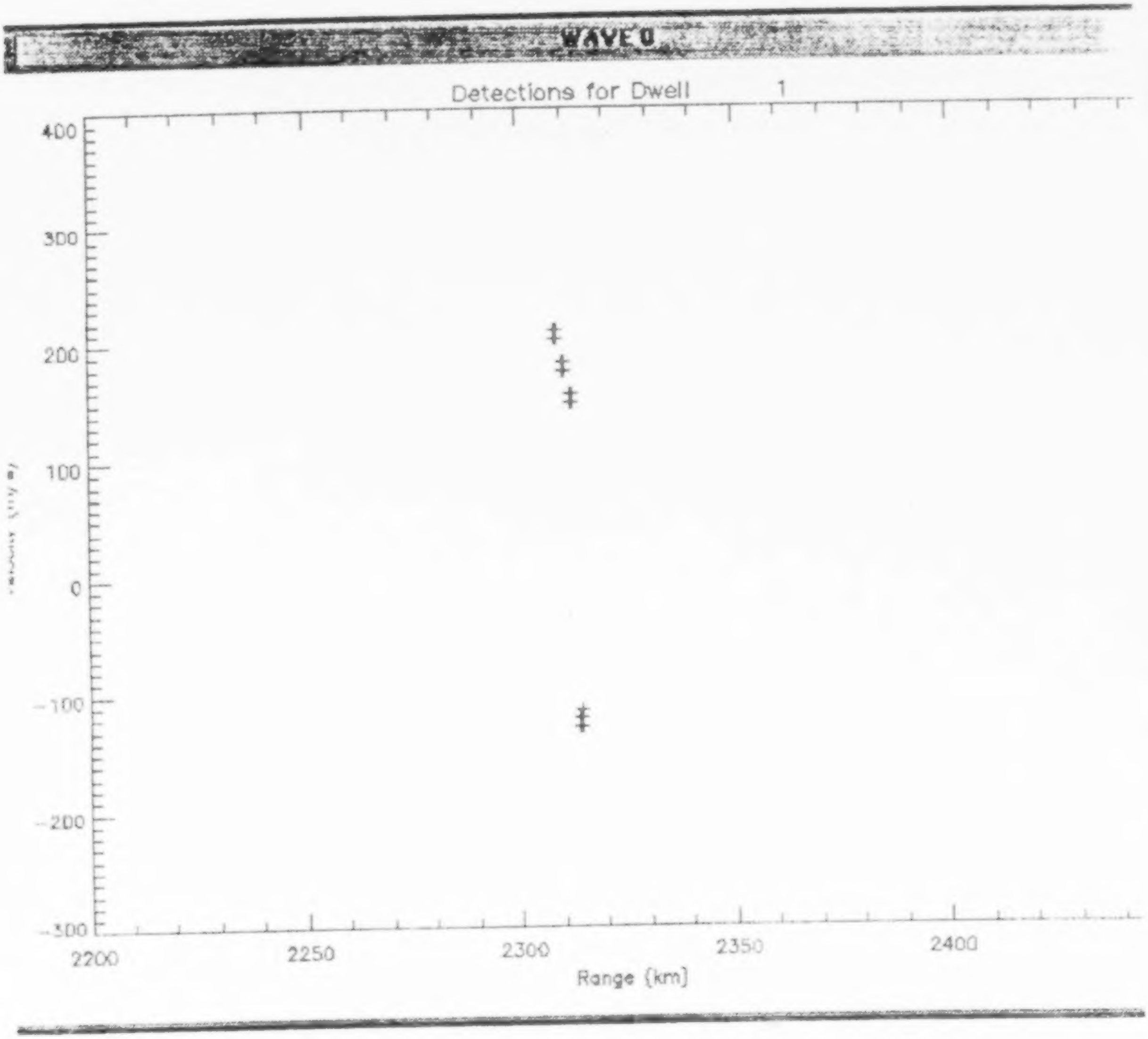
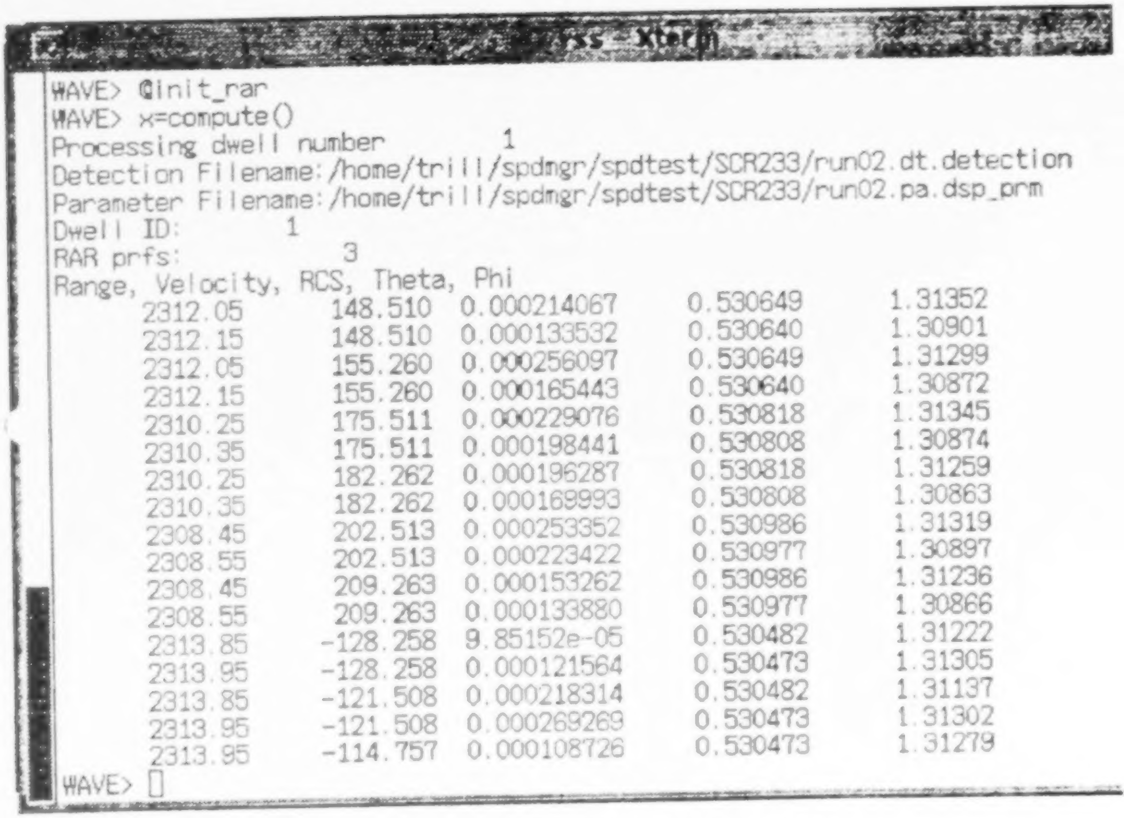


Figure G-10 Plot of Target Speed Vs Unambiguous Range

G3.2 Target Parameters Output

Numerical estimates of target parameters are generated by RAR/PE and printed in ASCII format in the window in which PVWave is running. Figure G-11 illustrates the target data that was plotted in Figure G-10.



```
WAVE> @init_rar
WAVE> x=compute()
Processing dwell number        1
Detection Filename:/home/trill/spdmgr/spdtest/SCR233/run02.dt.detection
Parameter Filename:/home/trill/spdmgr/spdtest/SCR233/run02.pa.dsp_prm
Dwell ID:        1
RAR prfs:            3
Range, Velocity, RCS, Theta, Phi
       2312.05      148.510  0.000214067      0.530649       1.31352
       2312.15      148.510  0.000133532      0.530640       1.30901
       2312.05      155.260  0.000256097      0.530649       1.31299
       2312.15      155.260  0.000165443      0.530640       1.30872
       2310.25      175.511  0.000229076      0.530818       1.31345
       2310.35      175.511  0.000198441      0.530808       1.30874
       2310.25      182.262  0.000196287      0.530818       1.31259
       2310.35      182.262  0.000169993      0.530808       1.30863
       2308.45      202.513  0.000253352      0.530986       1.31319
       2308.55      202.513  0.000223422      0.530977       1.30897
       2308.45      209.263  0.000153262      0.530986       1.31236
       2308.55      209.263  0.000133880      0.530977       1.30866
       2313.85     -128.258  9.85152e-05      0.530482       1.31222
       2313.95     -128.258  0.000121564      0.530473       1.31305
       2313.85     -121.508  0.000218314      0.530482       1.31137
       2313.95     -121.508  0.000269269      0.530473       1.31302
       2313.95     -114.757  0.000108726      0.530473       1.31279
WAVE> []
```

Figure G-11 Target Parameters Output Table

The following parameters are printed:

- **Dwell ID** indicates the dwell number counting from 1;
- **RAR PRFs** indicates the number of NCIs used to resolve unambiguous range (value of M in M of N).

For each resolved range/Doppler "hit":

- **Range** is the resolved target range in km;
- **Velocity** is the target radial velocity computed from the Doppler bin;
- **RCS** is a numerical value proportional to the estimated target radar cross section;

- **Theta** (θ) is the target depression angle measured from the satellite horizontal forward-right plane in radians. (See Figure G-12) Target $\theta = \pi/2$ corresponds to nadir (pointing straight down).

- **Phi** (ϕ) is the target azimuth scan angle relative to the satellite velocity (forward) vector in radians. (See Figure G-12). Range of scan angles is from $-\pi$ to π radians. Any antenna yaw is accounted for and removed from this scan angle.

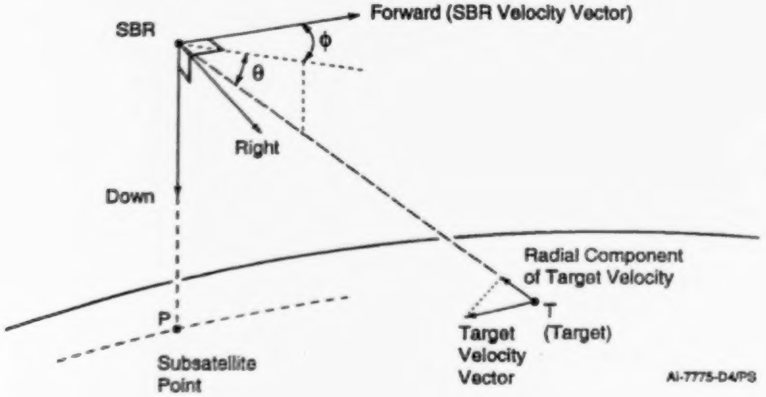

SBR
Forward (SBR Velocity Vector)
φ
θ
Right
Down
Radial Component of Target Velocity
T
(Target)
Target Velocity Vector
P
Subsatellite Point
AI-7775-D4/PS

Figure G-12 Illustration of Target Azimuth Scan and Depression Angles

APPENDIX H

INDEX TO HMI PARAMETERS

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TABLE OF CONTENTS

H. **INDEX TO HMI PARAMETERS** H-1
H1. INDEX TO HMI DIALOGUES BY TITLE H-1
H2. INDEX TO USER-ENTERED SIMULATION PARAMETERS H-3

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APPENDIX H

INDEX TO HMI PARAMETERS

This Appendix contains two cross-reference indices for dialogues and parameters in the three principal simulation definition HMIs: 1) Satellite/Radar, 2) Environment, and 3) Simulation Run.

Section H1. contains as alphabetical index to all HMI dialogues. This may be used to locate a particular dialogue box whose name is known.

Section H2. contains an alphabetical index to all HMI parameters in the dialogues. It may be used to locate specific Simulation parameters.

H1. INDEX TO HMI DIALOGUES BY TITLE

The following is an index of SPD HMI dialogues, sorted alphabetically by dialogue title, for all dialogues in Satellite/Radar, Environment and Simulation Run HMIs.

HMI Dialogue Title	HMI	Appendix/Para.
Adaptive Nulling	Simulation Run HMI	D2.3
Analog Effects (Main & Aux.. Channels)	Satellite/Radar HMI	B2.4.2
Arbitrary Array Definition	Satellite/Radar HMI	B2.5.3
ASAR DPCA (Run Level)	Simulation Run HMI	B2.10
ASAR DPCA (DI Level)	See DI Level: ASAR DPCA	
Atmosphere Definition	Environment HMI	C1.4
Auxiliary Operational Characteristics	Satellite/Radar HMI	B2.5.4
Auxiliary Physical Characteristics	Satellite/Radar HMI	B2.5.1
Background Clutter Definition	Environment HMI	C1.3
Blanker Selection	Simulation Run HMI	D2.1.2

HMI Dialogue Title	HMI	Appendix/Para.
CFA Antenna Patterns	Satellite/Radar HMI	B2.4.3
CFA Operational Characteristics	Satellite/Radar HMI	B2.4.4
CFA Physical Characteristics	Satellite/Radar HMI	B2.4.1
CFAR (Run Level)	Simulation Run HMI	D2.13
CFAR (DI Level)	See DI Level: CFAR	D3.3
Chaff Bundle Definition	Environment HMI	C1.12
Channel Selections	Satellite/Radar HMI	B2.2
Clutter Patch Definition	Environment HMI	C1.8
Copy Definition	Satellite/Radar HMI	A2.3
CPI Definition	Satellite/Radar HMI	B2.12
Create Definition	Satellite/Radar HMI	A2.4
Data Reduction Options (Signal Generation)	Satellite/Radar HMI	
Data Reduction Options (Simulation Run)	Simulation Run HMI	D2.17
DI Level: ASAR DPCA	Simulation Run HMI	D3.2
DI Level: CFAR	Simulation Run HMI	D3.3
DI Level: Pulse Doppler	Simulation Run HMI	D3.1
DI Level: RAR	Simulation Run HMI	D3.4
Digital PMC	Simulation Run HMI	D2.2
Digital PMC (NCI Level)	See NCI Level: Digital PMC	
Discrete Seed	Environment HMI	C1.9.1
DSP Configuration	Simulation Run HMI	D2.1
Dwell Definition	Satellite/Radar HMI	B2.10
Earth Clutter Seed	Environment HMI	C1.8.1
Earth Discrete Clutter Definition	Environment HMI	C1.9
ESP Data Capture Options	Simulation Run HMI	D2.7
ESP Products	Simulation Run HMI	D2.8
External Noise Definition	Environment HMI	C1.6
Formed Beam Selection	Simulation Run HMI	D2.1.1
FOV Display	Environment HMI	C1.1
Generation Options	Satellite/Radar HMI	B2.9
Ionosphere Definition	Environment HMI	C1.5
Jammer Definition	Environment HMI	C1.11
MASR DPCA	Simulation Run HMI	D2.5
Multipath Definition	Satellite/Radar HMI	B2.3.1
NCI (Run Level)	Simulation Run HMI	D2.12
NCI Interval Definition	Satellite/Radar HMI	B2.11
NCI Level: Digital PMC	Simulation Run HMI	D4.1
NCI Level: NCI	Simulation Run HMI	D4.2
Nulling Systems	Simulation Run HMI	D2.1.3
Orbital Position	Satellite/Radar HMI	B2.6

HMI Dialogue Title	HMI	Appendix/Para.
Post-Doppler Blanking	Simulation Run HMI	D2.11
Pre-Doppler Blanking	Simulation Run HMI	D2.4
Precipitation Cell Definition	Environment HMI	C1.7
Pulse Compression	Simulation Run HMI	D2.9
Pulse Doppler (Run Level)	Simulation Run HMI	D2.6
Pulse Doppler (DI Level)	See DI Level: Pulse Doppler	
Radar Concept	Satellite/Radar HMI	B2.1
RAR	See DI Level: RAR	D3.4
Receiver Front End	Satellite/Radar HMI	B2.3
Regular Array Definition	Satellite/Radar HMI	B2.5.2
RRA Antenna Patterns	Satellite/Radar HMI	B2.4.6
RRA Operational Characteristics	Satellite/Radar HMI	B2.4.7
RRA Physical Characteristics	Satellite/Radar HMI	B2.4.5
RSP Data Capture Options	Simulation Run HMI	D2.15
RSP Products	Simulation Run HMI	D2.16
RSS Data Capture Options	Satellite/Radar HMI	B2.7
Satellite/Radar Definition (Top Level)	Satellite/Radar HMI	B1.2
Simulation Run Definition (Top-level)	Simulation Run HMI	D1.2
Target Definition	Environment HMI	C1.10
Time Edit	Environment HMI	C1.2
Time Varying Parameters Table (read-only)	Environment HMI	C1.2
Volumetric Seed	Environment HMI	C1.7

H2. INDEX TO USER-ENTERED SIMULATION PARAMETERS

The following is an index to all user-entered parameters in the Satellite/Radar, Environment and Simulation Run HMIs, sorted into alphabetical order by parameter name. Acronyms are sorted according to their contracted form.

Parameter	Dialogue
A/D Character	Analog Effects
A/D Dynamic Range	Receiver Front End
A/D Non-Linearity Polynomial Coefficients	Analog Effects
Altitude (Satellite)	Orbital Position
Altitude (Target)	Target Definition
Altitude (Jammer)	Jammer Definition
Altitude (Chaft)	Chaff Bundle Definition
Altitude of Maximum Ionization	Ionosphere Definition
Amplitude Mismatch	See I/Q Imbalance
Antenna	See specific characteristics, e.g., Aperture, Attitude, Element Grid, etc.

Parameter	**Dialogue**
Antenna Patterns	See CFA or RRA Antenna Patterns dialogues depending on concept
Aperture, Across Motion	CFA Physical Characteristics
Aperture, Across Motion (Y)	Regular Array Definition (Auxiliary)
Aperture, Along Motion	CFA Physical Characteristics
Aperture, Along Motion (X)	Regular Array Definition (Auxiliary)
Array Tracking (Enable)	Regular Array Definition (Auxiliary)
Array Tracking (Enable)	Arbitrary Array Definition (Auxiliary)
ASAR DPCA Enable	ASAR DPCA
Attitude - CFA (Roll, Pitch, Yaw)	CFA Operational Characteristics
Attitude for Fixed Aux. (Roll, Pitch, Yaw)	Auxiliary Operational Characteristics
Attitude for Rotating Auxiliary (Az Offs, Elev.)	Auxiliary Operational Characteristics
Attitude of Plane of Rotation, Pitch	RRA Operational Characteristics
Attitude of Plane of Rotation, Roll	RRA Operational Characteristics
Augmented Doppler Decimation (start, step, stop)	Data Reduction Options
Auxiliary Antenna Element Pattern	Auxiliary Physical Characteristics
Auxiliary Antenna, Type"	Auxiliary Physical Characteristics
Auxiliary Array Weight	Regular Array Definition (Auxiliary)
Auxiliary Horn Gain	Auxiliary Physical Characteristics
Auxiliary Near Sidelobe Level	Regular Array Definition (Auxiliary)
Auxiliary/Tap Delay Selection	Channel Selections
Average Lobe Width	Multipath Definition
Average Reflectivity	Multipath Definition
Background Clutter Enable	Background Clutter Definition
Background Clutter Type	Background Clutter Definition
Bandwidth (Receiver)	Receiver Front End
Bandwidth (Jammer)	Jammer Definition (Barrage)
Beam Centre Location (Lat, Long, Az, Grazing)	Orbital Position
Beam Centre Location (Lat., Long.)	Orbital Position
Beam Centre Location Method	Dwell Definition
Blanked Data Enable	RSP Data Capture Options
Blanked Data Select	ESP Data Capture Options
Blanker 1 (Pre, Post-Doppler Select)	Blanker Selection
Blanker 1 Nulling Select	Nulling System
Blanker 2 (Pre, Post-Doppler Select)	Blanker Selection
Blanker 2 Nulling Select	Nulling System
Blanker 3 (Pre, Post-Doppler Select)	Blanker Selection
Blanker 3 Nulling Select	Nulling System
Blanker 4 (Pre, Post-Doppler Select)	Blanker Selection
Blanker 4 Nulling Select	Nulling System
Boresight Azimuth (at start of CTI)	RRA Operational Characteristics
Boresight Offset Scan Angles (Vert, Horz)	Dwell Definition
Capture A/D Output	RSS Data Capture Options
Capture Clutter Signal	RSS Data Capture Options
Capture Composite Signal	RSS Data Capture Options
Capture CPI Enable	Satellite/Radar Definition

Parameter	**Dialogue**
Capture CPI Enable	Simulation Run Definition
Capture Dwell Enable	Simulation Run Definition
Capture External Noise	RSS Data Capture Options
Capture IF Filler Response	RSS Data Capture Options
Capture Jammer Enable	Jammer Definition
Capture Jammer Signals	RSS Data Capture Options
Capture NCI Enable	Simulation Run Definition
Capture Post-Non-Linearity Signal	RSS Data Capture Options
Capture Post IF-Filler	RSS Data Capture Options
Capture Post-Sync Detector	RSS Data Capture Options
Capture Rx Antenna Pattern	RSS Data Capture Options
Capture Target Signals	RSS Data Capture Options
Capture Tx Antenna Pattern Enable	RSS Data Capture Options
Centre Frequency	Jammer Definition (Barrage)
Chaff Bundle ID	Chaff Bundle Definition
Chaff Clutter Seed	Chaff Bundle Definition
Chaff Clutter Seed Source	Chaff Bundle Definition
Channel Combination	Post-Doppler Blanking
Channel Combination Select	Pre-Doppler Blanking
Clutter Patch ID	Clutter Patch Definition
Clutter Patch Vertex (Lat., Long.)	Clutter Patch Definition
Clutter Type	Clutter Patch Definition
Compressed Pulse Width	Dwell Definition
CPI Level Select	Satellite/Radar Definition
CPI Level Select	Simulation Run Definition
CPI Select	Time Edit
DC Offsets	Analog Effects
Deception Method	Jammer Definition (Deception)
Delay Taps (up to 3 delay values)	Auxiliary Physical Characteristics
Derived Location (Az., Grazing)	Dwell Definition
Detector Type Select	CFAR
Deweighting Parameter	ASAR DPCA
Diagonal Loading Constant	Adaptive Nulling
Diameter	See main reflector, Diameter and Subreflector, Diameter parameters
Direct Location (Lat., Long.)	Dwell Definition
Discrete Clutter ID	Earth Discrete Clutter Definition
Discrete Clutter Location (Lat., Long.)	Earth Discrete Clutter Definition
Discrete Clutter Type	Earth Discrete Clutter Definition
Discrete Random Seed	See Discrete Seed dialogue
Dispersion Efficiency	Chaff Bundle Definition
Displacement from Aperture Centre (Group 1,2: X,Y)	CFA Physical Characteristics
Doppler Augment Enable (PC, NCI, none)	DI Level: Pulse Doppler
Doppler Decimation (start, stop, step)	Data Reduction Options
Doppler Quantization Factor	Generation Options
Doppler Width	DI Level: CFAR

Parameter	Dialogue
Doppler-Compensated Replicas Enable	Pulse Compression
DPCA Group Select	See Formed Beam Selection dialogue
DPCA Mode	DSP Configuration
DPCA Weights Enable	RSP Products
Duty Cycle	Jammer Definition (Barrage)
Duty Cycle	Jammer Definition (Swept)
Duty Cycle	Jammer Definition (Follower)
Dwell Level Select	Satellite/Radar Definition
Dwell Level Select	Simulation Run Definition
Dwell Select	Time Edit
Earth Clutter Power Threshold	Generation Options
Earth Clutter Random Seed	See Earth Clutter Seed dialogue
Electron Density	Ionosphere Definition
Element Grid (Type)	Regular Array Definition (Auxiliary)
Element Grid Spacing (X,Y)	CFA Physical Characteristics
Element Grid Spacing (X,Y)	Regular Array Definition (Auxiliary)
Element Grid Type	CFA Physical Characteristics
Element Pattern	CFA Physical Characteristics
Equalization Parameters	Analog Effects
ERP	Jammer Definition
External Noise Model Enable	External Noise Definition
External Noise Random Seed	External Noise Definition
External Noise Seed Source	External Noise Definition
False Target ID	Jammer Definition (Deception)
False Target Characteristics	See Range Offset, Speed Offset
Feed Diameter	RRA Physical Characteristics
Feed Receive Near Sidelobe Level	RRA Physical Characteristics
Feed Receive Weight	RRA Physical Characteristics
Feed RMS Aperture Distribution Error	RRA Physical Characteristics
Feed Transmit Near Sidelobe Level	RRA Physical Characteristics
Feed Transmit Weight	RRA Physical Characteristics
FFT Length (Pulse Doppler)	DI Level: Pulse Doppler
Fixed Amplitude Weight	Arbitrary Array Definition (Auxiliary)
Fixed Phase Shift	Arbitrary Array Definition (Auxiliary)
Focal Length	See Main Reflector, Subreflector
Footprint Length	DI Level: RAR
Formed Beam 1 (Select)	Formed Beam Selection
Formed Beam 1 Nulling Select	Nulling System
Formed Beam 2 (Select)	Formed Beam Selection
Formed Beam 2 Nulling Select	Nulling System
Frequency Alignment Enable	Digital PMC
Frequency Band	Radar Concept
Gate Step	DI Level: ASAR DPCA
Guard Doppler Width	DI Level: CFAR

Parameter	**Dialogue**
Guard Range Width	DI Level: CFAR
Heading (Target)	Target Definition
Heading (Jammer)	Jammer Definition
Horn Gain	CFA Physical Characteristics (also see Auxiliary Horn Grain)
Humidity	See Relative Humidity Select
I/Q Imbalance (Amplitude & Phase)	Analog Effects
IF & Equalizer Character	Analog Effects
IF Filter File Name	Analog Effects
Inclination	See Orbital Inclination parameter
Initial Subsatellite Point Location Method	Orbital Position
Initial Time of Day (h/m/s)	Orbital Position
Input Data Select	ESP Data Capture Options
Input Data Select	RSP Data Capture Options
Instantaneous Bandwidth	Jammer Definition (Swept)
Instantaneous Bandwidth	Jammer Definition (Follower)
Integration Algorithm Select	NCI
Ionosphere Model Enable	Ionosphere Definition
Jammer ID	Jammer Definition
Jammer Seed	Jammer Definition
Jammer Seed Source	Jammer Definition
Jammer Type	Jammer Definition
Kaiser Sidelobe Level (PD)	Pulse-Doppler
Kaiser Sidelobe Level (PC)	Pulse Compression
Land Clutter Wind Speed	Background Clutter Definition
Land Clutter Wind Speed	Clutter Patch Definition
Location (Lat., Long.) (Precipitation Cell)	Precipitation Cell Definition
Location (Lat., Long.) (Target)	Target Definition
Location (Lat., Long.) (Jammer)	Jammer Definition
Location (Lat., Long.) (Chaff)	Chaff Bundle Definition
Location (X,Y,Z, of Aux. Array Element)	Arbitrary Array Definition (Auxiliary)
Lower Altitude	Precipitation Cell Definition
Lower Atmosphere Enable	Atmosphere Definition
Magnitude Squared Enable	Data Reduction Options
Magnitude Squared Enable	Data Reduction Options
Main Beam Delay	Receiver Front End
Main Reflector, Diameter	RRA Physical Characteristics
Main Reflector, Focal Length	RRA Physical Characteristics
MASR DPCA Enable	MASR DPCA

Parameter	Dialogue
MASR Weights (Adaptive Enable)	MASR DPCA
Mid-Band Frequency (SBR)	Radar Concept
Mid-Sweep Frequency (Jammer)	Jammer Definition (Swept)
Monopulse Angle Enable	RSP Data Capture Options
Monopulse Enable	DSP Configuration
Monopulse Lube Select	See Formed Beam Selection dialogue
Motion Compensation	Receiver Front End
NCI Level Select	Satellite/Radar Definition
NCI Level Select	Simulation Run Definition
NCI Select	Time Edit
Noise Seed	See External Noise Random Seed
Noise Temperature	See Receiver Noise Temperature
Noise Threshold (Pre-Doppler Blanking)	Pre-Doppler Blanking
Noise Threshold (Range-Doppler Blanking)	Post-Doppler Blanking
Nominal Carrier Frequency	NCI
Nominal PRF	NCI
Non-Linear Character	Analog Effects
Non-Linear Parameters	Analog Effects
Notch Filter Length	Adaptive Nulling
Notch Filter Weights	Adaptive Nulling
Nulled Data Select	ESP Data Capture Options
Number of Auxiliaries	Channel Selections
Number of Bursts Integrated	NCI Level: NCI
Number of Delay Taps	Selected for each Auxiliary in Channel Selections dialogue
Number of DPCA Doppler Bins	DI Level: ASAR DPCA
Number of DPCA Groups	Channel Selections
Number of Dwells	Define in Satellite/Radar Definition (top-level)
Number of Elements	Arbitrary Array Definition (Auxiliary)
Number of False Targets	Jammer Definition (Deception)
Number of Multipath Scatterers	Multipath Definition
Number of PCs Used in MASR DPCA	See Formed Beam Selection dialogue
Number of Phase Centres per Group	Channel Selections
Number of Pre-Doppler Blankers	DSP Configuration
Number of PRFs Used	DI Level: RAR
Number of Pulses Processed	NCI Level: Digital PMC
Number of Range Gates to Compute Weights	DI Level: ASAR DPCA
Number of Range-Doppler Blankers	DSP Configuration
Number Rejected (Snapshots)	Adaptive Nulling
Numerical Stability Threshold	Adaptive Nulling

Parameter	Dialogue
Offset Frequency	Jammer Definition (Follower)
Orbital Inclination	Orbital Position
OS Rank (NCI)	NCI Level: NCI
OS Rank (OS-CFAR)	DI Level: CFAR
Oversampling Factor, Earth Clutter	Generation Options
Oversampling Factor, Jammer and Noise	Generation Options
PC Replicas Enable	RSP Products
PD Window Select	ESP Products
Peak Power	Dwell Definition
Phase Centre Location (X, Y, Z)	Auxiliary Physical Characteristics
Phase Mismatch	See I/Q Imbalance
Pitch	See Attitude (CFA, RRA, Aux) parameters
Polarization	Receiver Front End
Position (X,Y,Z)	Multipath Definition
Post CPI Delay	CPI Definition
Post-CC Data Select	RSP Data Capture Options
Post-FA Data Select	ESP Data Capture Options
Post-MASR Data Select	ESP Data Capture Options
Post-NCI Data Enable	RSP Data Capture Options
Post-PC Data Select	RSP Data Capture Options
Post-PD Data Select	ESP Data Capture Options
Post-SC Data Select	ESP Data Capture Options
Precipitation Cell Radius	Precipitation Cell Definition
PRI Multiplier	CFA Physical Characteristics
Probability of False Alarm	DI Level: CFAR
Processing Delay	Jammer Definition (Follower)
Pulse Compression Enable	Pulse Compression
Pulse Doppler Enable	Pulse-Doppler
Pulse Duration (Transmitted)	Dwell Definition (also see Compressed Pulse Width parameters)
Pulse Type	Receiver Front End
Pulses per CPI	NCI Interval Definition
QPM Enable	Dwell Definition
Quantity of Water	Precipitation Cell Definition
R-Matrices & r-Vectors Select	ESP Products
Radar Concept	Radar Concept
Random Seed (various)	See specific dialogue (Earth Clutter, Discrete, Volumetric) seed

Parameter	Dialogue
Range Decimation (start, stop, step) (Signal Generation)	Data Reduction Options (Signal Generation)
Range Decimation (start, stop, step) (Signal Generation)	Data Reduction Options (Simulation Run)
Range Gate Selection	DI Level: ASAR DPCA
Range Offset	Jammer Definition (Deception)
Range Quantization Factor	Generation Options
Range Width	DI Level: CFAR
RCS	Target Definition
RCS Data Enable	RSP Data Capture Options
RCS Median	Earth Discrete Clutter Definition
RCS Peak	Earth Discrete Clutter Definition
RCS Profile Select	Target Definition
Receive Antenna (Filename)	CFA Antenna Patterns
Receive Antenna (Filename)	RRA Antenna Patterns
Receive Array Near Sidelobe Level	CFA Physical Characteristics
Receive Array Weight	CFA Physical Characteristics
Receiver Noise Temperature	Analog Effects
Reflector Design	RRA Physical Characteristics
Reflector Elevation	RRA Operational Characteristics
Relative Humidity Select	Atmosphere Definition
RF Bandwidth	Radar Concept
RF Frequency	CPI Definition
RMS Aperture Distribution Error	CFA Physical Characteristics (see Feed RMS Aperture Distribution Error for RRA)
Roll	See Attitude (CFA, RRA, Aux.) parameters
Rotation Rate	RRA Operational Characteristics
RSS Generated Values Enable (False Targets)	Jammer Definition (Deception)
Samples per PRI	NCI Interval Definition
Sampling Alignment Enable	NCI
Sampling Correction Enable	Digital PMC
Sampling Correction Filter Length	Digital PMC
Sampling Correction Update Interval	Digital PMC
Sampling Rate	Receiver Front End
Satellite Direction (N, S)	Orbital Position
Scale Height of Neutral Particles	Ionosphere Definition
Scintillation Index	Ionosphere Definition
Scintillation Random Seed	Ionosphere Definition
Scintillation Seed Source	Ionosphere Definition
Sea Clutter Sea State (Background)	Background Clutter Definition
Sea Clutter Sea State (Clutter Patch)	Clutter Patch Definition

Parameter	**Dialogue**
Sea Clutter Wind Direction	Background Clutter Definition
Sea Clutter Wind Direction	Clutter Patch Definition
Seed Source	See specific dialogue (Earth Clutter, Discrete, Volumetric Seed)
Shape and Size (Clutter)	See Clutter Patch Vertex
Site (Non-rotating or rotating aux.)	Auxiliary Operational Characteristics
Slope Threshold	Pre-Doppler Blanking
Slope Threshold	Post-Doppler Blanking
Snapshot Editing Enable	Adaptive Nulling
Snapshot Selection	Adaptive Nulling
Snapshot Smoothing Period	Adaptive Nulling
Snapshots per Smoothing Interval	Adaptive Nulling
Snapshots Select	ESP Products
Spectral Width (Discrete Clutter)	Earth Discrete Clutter Definition
Spectral Width (Target)	Target Definition
Speed (Target)	Target Definition
Speed (Jammer)	Jammer Definition
Speed Offset	Jammer Definition (Deception)
Stagger Tuning	Chaff Bundle Definition
Start Gate	DI Level: ASAR DPCA
Strobe Frequency	Jammer Definition (Barrage)
Strobe Frequency	Jammer Definition (Swept)
Strobe Frequency	Jammer Definition (Follower)
Subreflector, Diameter	RRA Physical Characteristics
Subreflector, Focal Length	RRA Physical Characteristics
Subsatellite Location (Lat., Long.)	Orbital Position
Sweep Rate	Jammer Definition (Swept)
Swept Bandwidth	Jammer Definition (Swept)
Tap Delay	See Delay Taps
Target Clutter Seed	Target Definition
Target Clutter Seed Source	Target Definition
Target Deweighting Function Enable	RSP Products
Target ID	Target Definition
Target Range Walk Compensation Enable	NCI
Temperature	Precipitation Cell Definition
Time Decimation (start, stop, step) (Signal Gen.)	Data Reduction Options (Signal Generation)
Time Decimation (start, stop, step) (Simulation Run)	Data Reduction Options (Simulation Run)
Tracking Array Enable	See Array Tracking Enable
Tracking Array Offset (Elev., Azim.)	Regular Array Definition (Auxiliary)
Transmit Antenna (Filename)	CFA Antenna Patterns
Transmit Antenna (Filename)	RRA Antenna Patterns
Transmit Array Near Sidelobe Level	CFA Physical Characteristics

Parameter	Dialogue
Transmit Array Weight	CFA Physical Characteristics
Type (Antenna Pattern)	CFA Antenna Patterns
Type (Antenna Pattern)	RRA Antenna Patterns
U-Matrices & z-Vectors Select	ESP Products
Unambiguous PRF	DI Level: Pulse Doppler
Update Intervals / Smoothing Interval	Adaptive Nulling
Upper Altitude	Precipitation Cell Definition
User-Entered Weights (Notch Filter)	Adaptive Nulling
Velocity Alignment Enable	NCI
Volumetric Random Seed	See Volumetric Seed dialogue
Water State	Precipitation Cell Definition
Weight (physical weight of Bundle)	Chaff Bundle Definition
Weight Size Threshold (Nulling Equations)	Adaptive Nulling
Weight Size Threshold Enable	Adaptive Nulling
Weight Vectors Select	ESP Products
Wind Direction (Precipitation)	Precipitation Cell Definition
Wind Direction (Chaff)	Chaff Bundle Definition
Wind Direction (Sea Clutter)	See Sea Clutter Wind Direction
Wind Speed (Precipitation)	Precipitation Cell Definition
Wind Speed (Chaff)	Chaff Bundle Definition
Wind Speed (Clutter)	See Land Clutter Wind Speed
Window Type (PD)	Pulse-Doppler
Window Type (PC)	Pulse Compression
Yaw	See Attitude (CFA, Aux.) parameters

APPENDIX I

NOTES ON SPD DEVELOPMENT ENVIRONMENT

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FIGURES

Figure I-1 PVWave Start-up Script I-7

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APPENDIX I

NOTES ON SPD DEVELOPMENT ENVIRONMENT

This appendix contains some notes concerning the software development/integration/test environment of the SPD, useful for maintaining or altering the SPD software. The following is an index:

1. **Configuration Management Procedures** outlines the procedures used during SPD integration and test to control and manage changes to the software.
2. **Directories Under the Developer** describes the organization of user directories for the software developers. All SPD software was developed and tested on the delivered SPD system. Corporate computing facilities at MacDonald Dettwiler and Raytheon Canada were used only for backup capability, E-mail access, and non-deliverable items (e.g., Matlab simulations, work status reporting, etc.)
3. **CML Commands** describes frequently used Configuration Management LIbrary commands used by developers to report problems and document changes to the software.
4. **Testing Environment** describes the integration and testing environment, and organization of test results.

I1. CONFIGURATION MANAGEMENT PROCEDURES

During system development the software developers used Configuration Management Library (CML) to manage version change of the SPD. This was used to report problems by raising System Change Requests (SCRs), record changes by raising Change Records (CRs), fetch source codes from the CML, and submit files to the CML.

After an SCR is raised, the CM appraiser, typically the Software Team Leader accesses the SCR to determine whether it is a real problem, adds comments to the SCR if necessary, assigns a priority to the SCR (High, Medium or Low), and assigns a particular hardware/software engineer to solve this problem.

The appraiser must periodically examine newly created SCRs and assign them to hardware/software engineers based on priorities, schedules, and budgets. Once an SCR has been assigned, the hardware/software engineer may actually modify source code to solve the problem.

The hardware/software engineer will report a change by raising a CR, describing solution and all Computer Units (CUs, i.e., an include file, a software module) affected. After testing is completed, the hardware/software engineer submits the new/modified modules to the CM, and then notifies the CM approvers via e-mail.

CM approvers (CM Coordinator and Software Team Leader) check whether the solution is adequate before the SCR can be closed. After certain SCRs have been successfully solved, the CM will build executables using the recently released modules; a partial built or a full built is scheduled by both CM and System Engineer depending on SCR priorities and software dependency.

I2. DIRECTORIES UNDER THE DEVELOPER

Each developer has their own directory under /home/spdctlr/<user-id>. In their directory, each user has an "spd" directory tree that follows the directory tree structure in the SPDCM account. Under the /spd directory, each user has the following subdirectories:

- *bin* - the local directory containing executables
- *lib* - the local directory containing libraries
- *include* - the local directory containing include files
- *src* - the local directory containing source files

Under the "src" directory, the user may have the following Functional Area subdirectories /common, /ctlr, /rss, /rtsg, /esp or /esp depending on which functional area they are currently fixing. These directories are subdivided into CSU directories. For example, the RSS CSU software is located in the following directories:

- */home/spdctlr/<user-id>/spd/src/rss/sgen*
- */home/spdctlr/<user-id>/spd/src/rss/srun*
- */home/spdctlr/<user-id>/spd/src/rss/sbit*
- */home/spdctlr/<user-id>/spd/src/rss/sbmt*
- */home/spdctlr/<user-id>/spd/src/rss/sutl*

Only those CSUs that need to be modified need to have a subdirectory, i.e., not all CSU directories need to be created.

To modify existing CSUs, a shadow directory is created from the SPDCM account using the "lndir" command. For example, to create a shadow "sbmt" directory, do:

```
cd ~<user-id>/spd/src
mkdir rss
cd rss
mkdir sbmt
lndir $SPDRSS /sbmt sbmt
```

The directory "sbmt" will contain all files (makefile, include files, source files, and object files) with symbolic links pointing to the SPDCM's sbmt directory.

By using the shadow directory, disk space is reduced significantly compared to using *cp* command to duplicate files. In addition, when the CM has a newer release of source files, the developer does not need to recopy files, because the symbolic links always point to the files of the latest version from the SPDCM account.

In general, the SPDINC and SPDLIB environment variables point to the SPDCM directories by default; however, the user can change these environment variables to point to a later version, e.g., in their own development directory. These two environment variables must be set before compiling and linking software.

It is good practice to modify the makefile by changing the CFLAGS and LDFLAGS to add:

- *-I<directory name>* prior to -I$SPDINC
- -L<directory name> prior to -I$SPDLIB

to tell the compiler to search the include files or the libraries located in the specified directory first before looking for them in the SPDINC or SPDLIB directory.

I3. CML COMMANDS

The frequently used CML commands are summarized in this section for quick reference. Refer to the CML User Manual for details of CML command usage.

To invoke CML, type "cml" at the UNIX prompt.

```
%cml
CML> show scr *                    -   show all SCRs

CML> show scr * /sum               -   show summary of all SCRs

CML> show scr nnn                  -   show SCR #nnn
```

`CML> show scr nnn/outp=file_name` - output SCR #nnn to the specified filename

`CML> show scr */summ/outp=file_name` - output summary of all SCRs to the specified filename

`CML> add scr/title="...."/cate=software` - create a new SCR

`CML> mod scr nnn/desc/editor=vi` - modify SCR description

`CML> add cr/title="....."` - create a new CR

`CML> mod cr nnn/scr=xxx,yyy/cu=XXX.h,YYY.c` - modify CR with associated SCRs and CUs

`CML> mod cr nnn/desc/editor=vi` - modify CR description

`CML> submit cr nnn` - submit a CR

I4. TESTING ENVIRONMENT

During integration and testing, all system testing was performed under the SPDMGR account. Two test directories were created:

~spdmgr/qualtest - FAT qualification test directory which contains subdirectories of all subtest cases/ txx/cyy for test xx case yy.

~spdmgr/spdtest - Ad hoc testing for one particular testing purpcse. For example, jammer_bw_tests for testing jammer narrow bandwidth, and tests to close specific problem reports (SCR nnn).

In each subdirectory, a .spdrc file is required to specify the SPD application default directories:

PARM_DIR - Directory containing the parameter definition files, e.g., Satellite/Radar Definition file, Environment Definition file, and Simulation Run Definition file.

PROD_DIR - Directory containing the Intermediate product files generated by the RSS, the ESP, and the RSP, and the detection files generated by the RSP. The RSS derived processing parameter file and the DSP processing parameter file is also stored in this directory.

SRSD_DIR - Directory containing the simulated radar signal data file generated by the RSS.

LOGS_DIR - Directory containing the log file for the signal generation or the simulation run.

ANAL_DIR - Directory containing the PVWave Analysis files (not used).

To test a function, the developer/integrator logs in to either workstation as SPDMGR and then changes to a particular test subdirectory.

In that subdirectory, do:

source .spdrc - Set up the default directory to the current working directory, then execute one of the following commands.

satdef - Execute Sat/Rad Definition HMI.

envdef - Execute Environment Definition HMI.

rundef - Execute Simulation Run Definition HMI.

siggen - Execute Monitor/Control Signal Generation HMI.

simrun - Execute Monitor/Control Simulation Run HMI.

The SPD signal generation servers and simulation run servers can be monitored by using the following scripts:

genstatus - Monitor the status of signal generation processes.

genlog - Display the log file of the current signal generation.

simstatus - Monitor the status of simulation run processes.

Test results are saved in the related test case subdirectory, and key results were printed and put into the test results folder. System test cases are documented fully in the SPD Test Report, and additional debugging/integration data is kept in the System Integration & Test folder. This folder includes a binder of test results related to specific problem reports.

I5. CREATING A NEW VERSION OF DSP SOFTWARE

The SPD allows the user to customize the VASP Processing Element (PE) portion of the software which runs on the DSP. The PE Software Version Identifier in the Simulation Run HMI actually is the name of a softlink in *$SPDMGRBIN* to a directory that contains the executable binary files (both Executive Controller [EC] CPUs and PE Software) that are loaded by the DSP. The EC Software is loaded as part of CPU boot-up, and the PE Software is loaded and executed before a run begins.

To create a new version of ESP or RSP PE Software, one must first make the desired changes to the source files, then recompile and relink the object files to form new executables. The make files *make_esppe* and *make_rsppe* provided in the top-level directory for ESP and RSP sources, respectively, may be used to automate this process.

To make the new executable files available for use, create a new subdirectory under *~spdmgr/bin*, with the name *"dsp-xxxx"* where *xxxx* is any alphanumeric string that does not conflict with the existing versions. The user must be logged in to the SPDMGR account to do this. Copy the new executable DSP binary files to this subdirectory. Then go to the current directory indicated by the environment variable SPDMGRBIN and create a new softlink to the new DSP subdirectory.

Note that the actual path used by the ESP and RSP to the PE software is defined in the files:

~spdmgr/config/esp_config.dat
~spdmgr/config/rsp_config.dat

These must be consistent with that defined by SPDMGRBIN, as VxWorks is not able to access workstation environment variables.

I6. PVWAVE DATA ANALYSIS PROCEDURE FILES

Data analysis tools for the SPD are written in PVWave Command Language in the form of "procedures" or "functions". These are saved in files with the file naming convention **.pro*. PVWave is effectively an "interpretive" language meaning that the procedure or function is compiled when it is first called from PVWave. PVWave has its own search path defined by the environment variable *WAVE_PATH*. The shell script *init_wave* adds the path to SPD tools to the Wave path. Figure I-1 illustrates the *init_wave* start-up script.

```
#!/bin/csh
#
# Shell script to initialize path to 3dplot and data ingest routines, and then
# launch PVWave Command Language.
#
# 93.11.20 TAK Original
# 94.01.26 TAK Added path to ingest functions (includes expected detections)
# 94.07.26 CST Added path to the current path and ${SPDCTLR}/cdat
#              Added path to ingest rss functions
#              Added FILE_DIR environment variable
# 94.10.25 CST Changed SPDCTLR/cdat to SPDPVITOOLS
#              Removed FILE_DIR environment variable
setenv WAVE_GUI "MOTIF"
vnicl
setenv WAVE_PATH ${PWD}:${WAVE_PATH}
setenv WAVE_PATH ${WAVE_PATH}":"${SPDPVITOOLS}
setenv WAVE_PATH ${WAVE_PATH}":"${SPDPVITOOLS}/3dplots
setenv WAVE_PATH ${WAVE_PATH}":"${SPDPVITOOLS}/ingestcl
setenv WAVE_PATH ${WAVE_PATH}":"${SPDPVITOOLS}/2dplots
setenv WAVE_PATH ${WAVE_PATH}":"${SPDPVITOOLS}/ingestrss
wave
```

Figure I-1 PVWave Start-up Script

The following Subdirectories are under *SPDPVITOOLS*:

/2dplots	Two-dimensional (image intensity) plotting routines.
/3dplots	Three-dimensional (surface plot) plotting routines.
/ingestcl	Routines to ingest DSP intermediate results (data is saved in CL workspace for subsequent analysis).
/ingestrss	Routines to ingest and plot RSS intermediate results (data is not saved in CL workspace).

I7. PRINTING HMI DIALOGUES

There are two ways to get a hard copy print-out of an SPD HMI dialogue. One way is to use the OpenWindows "Snapshot" utility. "Snapshot" may be used to capture and print one window containing a dialogue. The Snapshot utility may be accessed by moving the mouse printer outside any windows and icons, then depressing the right mouse button.

Under "Snap Type" select "Window", and under Print → Options... Specify the printer *ps_sbr*. Then select "Snap" and click on the dialogue window. Snapshot will say "Snap succeeded", then print it by selecting "Print".

Two scripts are also provided with the SPD to capture the contents of an Xwindow and save to a file. These two scripts provide two choices of gray-scale conversion not available under "Snapshot". The scripts are used by typing the following at the Unix prompt:

% xplot	Map the X-window to black and white.
% xgplot	Map the X-window to grey tones.

Both functions are used as follows:

a) Bring the desired window to the foreground;

b) Run *xplot* or *xgplot*, select a size scale factor (2 = smallest, 4 = largest);

c) After selecting the scale factor, the mouse arrow is converted to a cross-hair;

d) Position the cross-hair anywhere inside the window to be captured and press the right mouse button;

e) The window will be captured in Postcript to a file *"id".ps*, where *"id"* is the window ID.

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The SPD Operator's Manual contains instructions for the operation of the SBR Signal Processing Demonstrator (SPD). This document is prepared in the format of a 2167A Computer System Operator's Manual.

The SPD is a laboratory-based computer system for the demonstration and validation of radar signal processing algorithms and real-time digital signal processing hardware for SBR.

The SPD consists of two subsystems: a Digital Signal Processor (DSP) and a Testbed. The DSP subsystem provides the demonstration of real-time signal processing for SBR signals. It consi of an ECCM Signal Processor (ESP) and a Radar Signal Processor (RSP).

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